Teaching and Learning in Engineering (TALE)
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Lecture - 12
Metacognitive Knowledge

Greetings and welcome to the Unit 12 of Module 1. It is related to Taxonomy of Learning particularly with focus on Metacognitive Knowledge.

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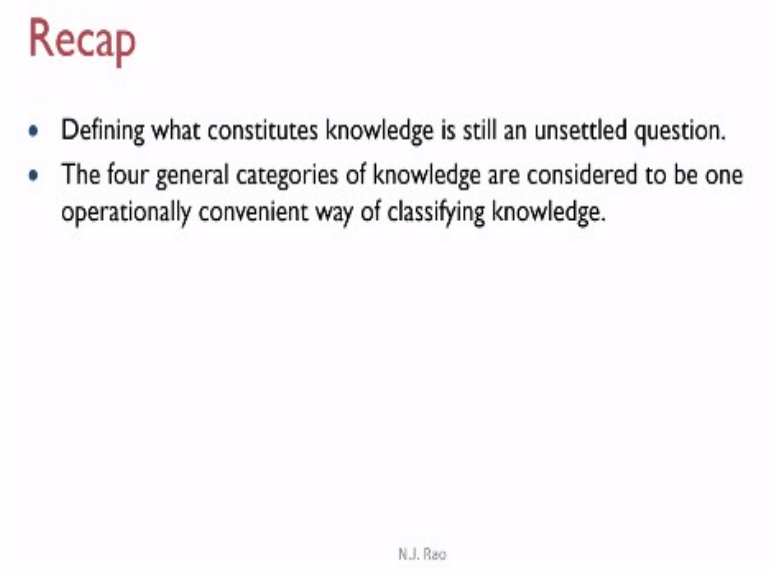

Earlier, in the earlier unit we looked at the nature of knowledge. We noted that defining what constitutes knowledge is still a unsettled question philosophically. So we did not make any attempt at all to try to define the word knowledge. At operative level, we have selected four general categories of knowledge namely Factual, Conceptual, Procedural, and Metacognitive knowledge and we gave a brief overview of these four categories of knowledge.

And what happens is while we define what a Metacognitive knowledge briefly, we felt in the context of our engineering education that learning a little more about metacognitive knowledge will greatly empower the teachers to take care of their own students.

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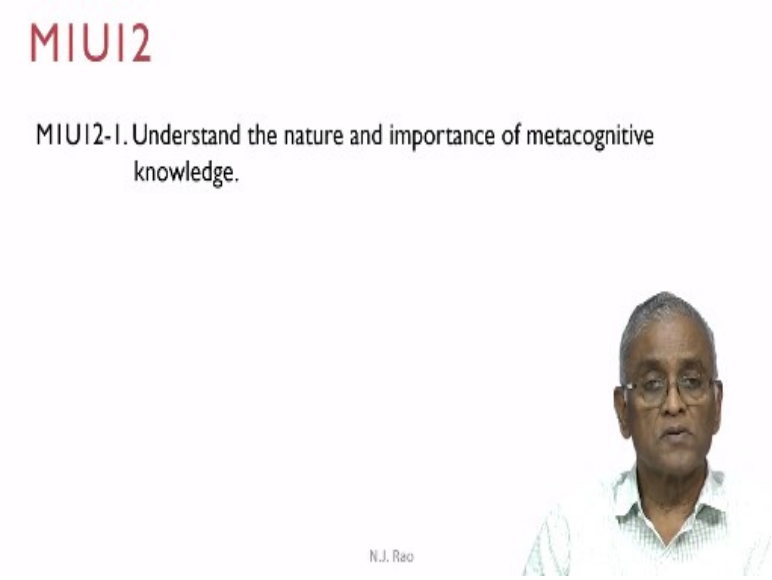

Now this unit the outcome is understand the nature and importance of metacognitive knowledge. We do not make any attempt at all to deal with it in detailed way nor about how the teacher should incorporate that into his instruction. That we will attempt at a/in a later module.

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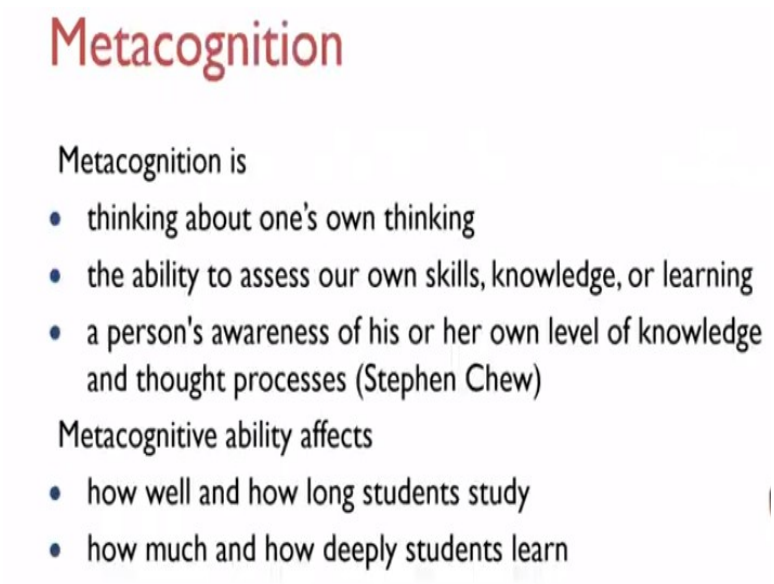

Coming to metacognition, what is it? Metacognition is thinking about one's own thinking. That is why we use the word meta. In that sense as we are thinking of our own thinking it becomes a higher order thinking ability. In other words, the ability to assess our own skills, knowledge, or learning or another way defined, a person's awareness of his or her own level of knowledge and thought processes.

This has been defined in several variants of the same definition and why is it important? Metacognitive ability affects how well and how long the student study. That is a very important component of a student's learning process. That too in a 4-year engineering course it will significantly influence how well and how long the student study. How much and how deeply the students learn also is affected by the metacognitive ability.

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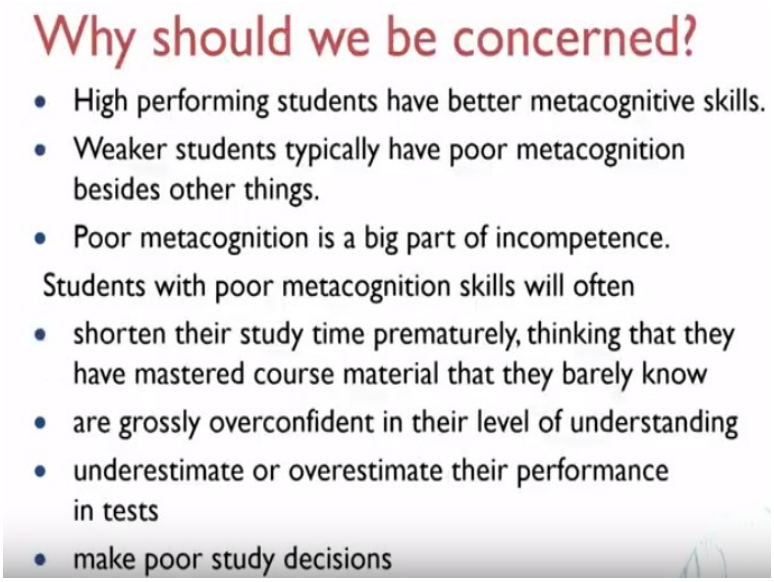

So to that extent this is central. Let us reemphasize why should we be concerned about metacognition? It is noted and there is adequate proof through research high performing students have better metacognitive skills. You take an institute and let us say in an autonomous institute especially, if you look at the performance of the students, high performing students generally have better metacognitive skills.

Whereas, weaker students typically have poor metacognitive skills besides other deficiencies. It would not be exclusively poor metacognition skills. There could be other deficiencies but poor metacognitive skill forms an important big part of his performance. So we can in the end say poor metacognition is a big part of incompetence. So if somebody is not able to perform, one of the areas the teacher should look at is his metacognitive ability.

And what do the students with poor metacognitive skills do? They shorten their study time prematurely thinking that they have mastered course material that they barely know. That means

they think they have mastered and they do not put any further effort in that and essentially they spend lot less time or grossly overconfident in their level of understanding and where does it get reflected? Either they underestimate or overestimate their performance in tests.

If you ask them how well you have performed in the class test and compare notes after they have actually obtained their grade or marks it is found that they either underestimate or overestimate their performance and because of all these they make poor study decisions. That means how to study, with whom to study, what to study, whom to ask, with whom to discuss, they make poor study decisions like that.

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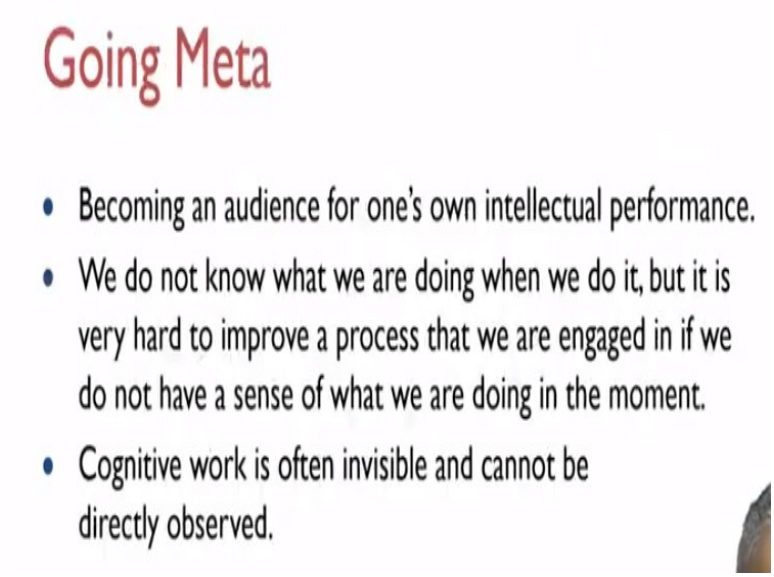

And saying why do we want to say meta? Going meta means becoming an audience for one's own intellectual performance. We do not know what we are doing when we do it. But it is very hard to improve a process that we are engaged in if you do not have a sense of what we are doing in the moment. For example when you are playing a game, to a certain extent because it is physical movements a player is generally aware of some of his defects.

But these days we have excellent tools where you can video the entire your play and then a coach can comment on that and can exactly pinpoint where you are actually doing. That means you value the feedback that is given to you when you are performing and that will greatly improve

your performance. And this is now routinely practiced in case of where physical activity is involved.

But where cognitive activity is involved by merely photographing, by video graphing when a person is working on a problem does not get you very much because it is not directly measurable. Cannot directly be observed. Because it is a mental process. And to that extent the only coach or here the teacher based on the behavior or actually based on what specific decisions the student is making at the time of solving the problem he only can guess whether to on what aspects of metacognition he is deficient and give feedback accordingly.

So going meta is truly speaking a higher thinking process, higher order thinking process and this is something that one has to learn by himself or herself if you want to keep improving.

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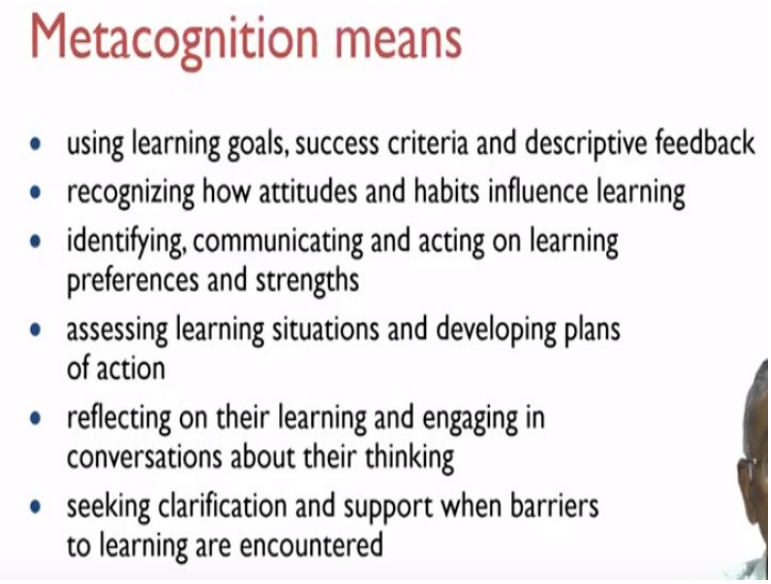

Now further what does metacognition, how does it manifest. For example the student uses the learning goals, success criteria and descriptive feedback. He is aware of all these. For example when he is working he knows what the learning goal is and when is he considered to have successfully learnt that success criteria he is aware of and also if somebody is giving feedback he can relate it to what he was doing.

So that is what a person with metacognitive ability will use learning goals, success criteria, and descriptive feedback. He also recognizes how attitudes and habits influence learning. Or he can identify, communicate and act on learning preferences and strengths. He can also assess learning situations and develop plans of action accordingly. That means he does not stick to one way of learning. It depends on he is able to develop his own plan as per the learning situation.

For example if you are learning a course in programming or if you are studying a descriptive course on materials your plan of action will be different for learning. Reflect on their learning and engage in conversation about their thinking. They often can be seen discussing with their colleagues, their friends or with the teacher about their thinking. Normally people refrain from that. And a person with metacognitive skills he is willing to talk to the both peers and coaches.

And students will seek clarification and support when barriers to learning are encountered. So they do not mind seeking support from the coach when you are unable to cross a certain barrier.
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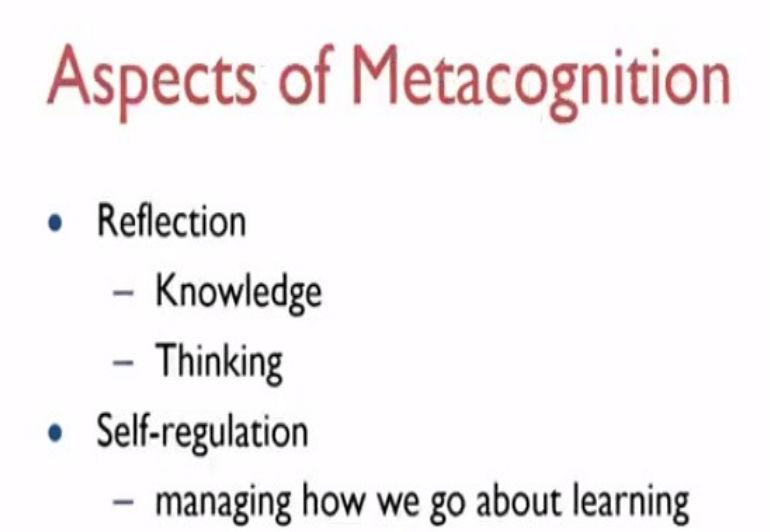

Okay, let us come to proper metacognition. In the literature they are broadly divided into two aspects. One is reflection. The other is self-regulation. Reflection can also be considered as awareness. Here either you are aware of your knowledge as well as you are aware of your own thinking process. Whereas self-regulation means how do I manage myself to go about learning. How do I manage? How do I manage the learning process? That is what self-regulation is.

One can be deficient in some aspect of metacognition, not necessarily in all aspects of metacognition. Now what happens grownup people once they get into their professional life they seem to have acquired reasonable metacognitive skills of how to go about solving a problem. They do not mind asking other people but at the time of in the age group that we are talking about the novice students you can say, novices will require some coaching with respect to metacognition.

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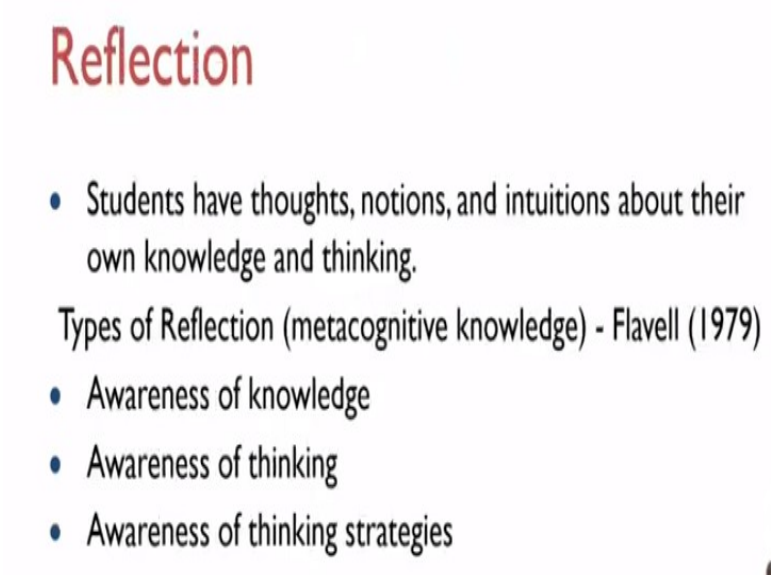

Now what is reflection? Students have thoughts, notions, and intuitions about their own knowledge and thinking. Now what are the types of reflection or awareness of knowledge? This is as per Flavell. Awareness of knowledge, awareness of thinking, and awareness of thinking strategies. What is awareness of knowledge? Understanding what one knows and what one does not know and what one wants to know. There are three.

What I know, what I do not know, what I want to know. An example is I know how to apply a given procedure but I do not know whether it can be applied in a given situation. This means he knows, the first two are satisfied. That is I know what I know but I do not know something else. Now what do I do with that particular awareness is the next level. But at least I do not know how to apply. But I do not take a position I know everything about this particular problem.

That is poor metacognitive knowledge. This awareness of knowledge also will include an awareness of other's knowledge. For example my friend knows something about what I do not know. If I have that knowledge I will go to that friend and ask. For example, I know that Sudha understands when the procedure can be applied. So I will ask her to explain it to me. So I take that position. That is good metacognitive awareness.

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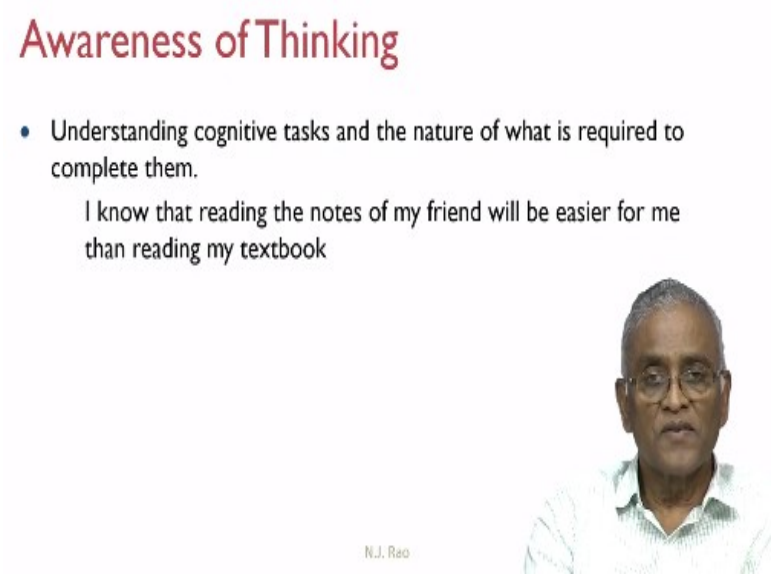

Now awareness of thinking. Understanding cognitive tasks and the nature of what is required to complete them. This is a very major thing and one maybe deficient in some aspects of thinking. Here simple example is I know that reading the notes of my friend will be easier for me than reading my textbook. This is an awareness of my thinking, okay?

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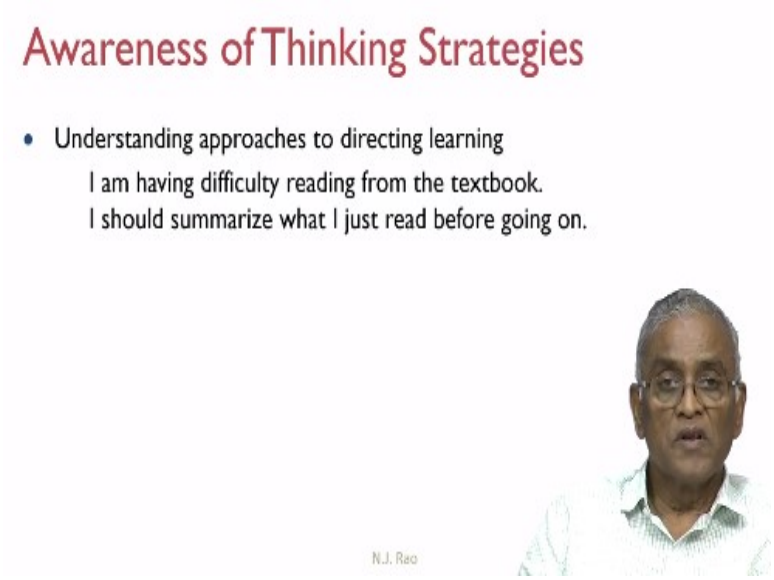

Similarly, awareness of thinking strategies that is understanding approaches to directing my learning. First thing my awareness and after that how do I direct my learning once I am aware of and I have several choices. I may have several strategies that I follow. For example one strategy is I am having difficulty in reading from the textbook. When I am having difficulty what is it that I follow? There are choices.

I may go and ask my friend to explain it to me or this is another strategy. I should summarize what I have just read before going out. So, for example summarizing is a very powerful tool to understand. So that is a strategy that I follow. That means I am aware of this particular strategy. So these are three types of awareness of knowledge and thinking.

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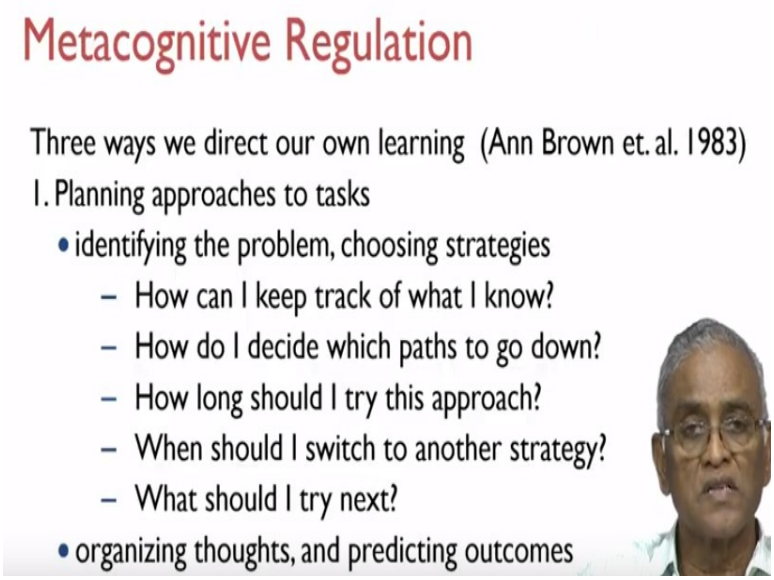

Now coming to metacognitive regulation. Now, I am aware of my abilities as well as inabilities. Now in that context I have to now plan how do I go about my learning. There are three ways we direct our learning according to Ann Brown. One is planning approaches to tasks. That will involve identifying the problem and choosing strategies and organizing thoughts and predicting outcomes.

So identifying the problem and choosing strategies would mean how can I keep track of what I know? How do I decide which paths to go down? How long should I try this approach? When should I switch to another strategy? What should I try next? Some people with good metacognitive skills are able to make a better choice between the various strategies that I have.

The planning approaches to task as we said that will involve identifying the problem and choosing strategies and organizing our thoughts and predicting the outcomes. For example many times when you are trying to solve a problem. You are following one approach. How much time should I follow this approach? When do I switch over to another strategy is a very very time-saving activity. And a person with good metacognitive skills will be able to do that.

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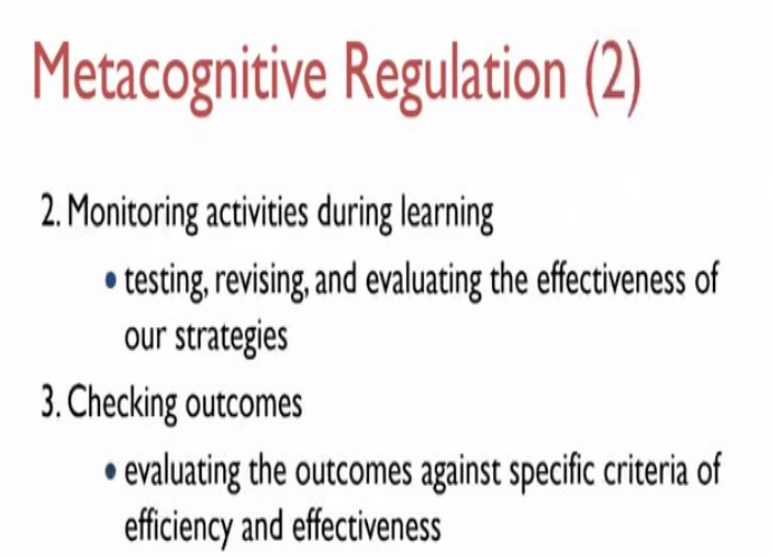

The other one is one is you are planning the tasks and going about it. Then what happens next is you should be able to monitor your activities during learning. That is while you are learning you must be able to test to what extent you have learnt based on that revise and evaluating the effectiveness of our own strategies. So one is able to monitor one's own self and that is a good metacognitive regulation.

Then what happens having done that, having monitored during the process you should be able to check the outcomes. That is having completed, you must be able to evaluate the outcomes against specific criteria of efficiency and effectiveness. You may be following certain method which is very very inefficiently, very time consuming and it is not effective. So I must be able to evaluate the outcome using or rather against some specific criteria which are efficiency and effectiveness.

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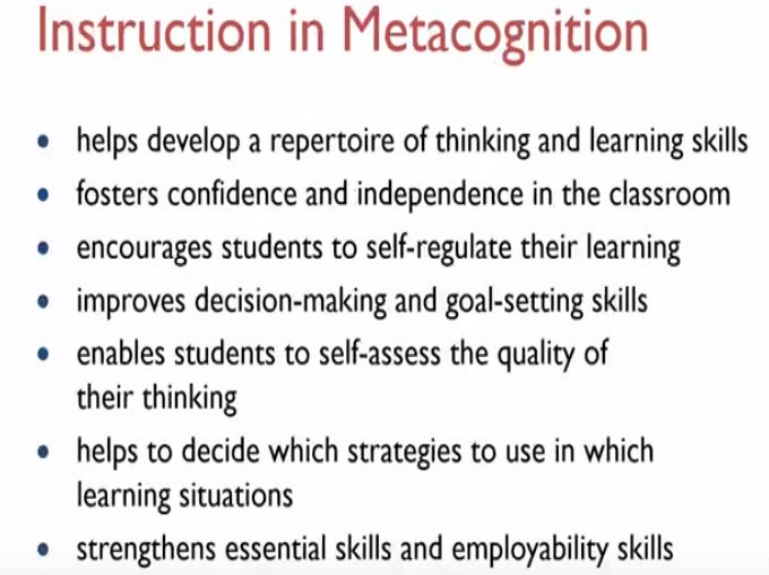

Now with all these knowledge an instructor or a teacher should incorporate some instruction in metacognitive during one's course. What we observed through our own field study is that high performing students in good institutions, mostly they have possibly reasonably satisfactory metacognitive skills though you will still find small percentage of people with inadequate metacognitive skills.

But as you keep coming down the rank order/rank orders of the college and where you have somewhat students with so called very high ranks that is CET rankings, very high CET rank come that is where they have very poor metacognitive abilities plus they come with very strong negative habits and attitudes. And that they can only be overcome through instruction and metacognition.

While this is not part of regular classroom teaching as of today because either because teacher is not aware of it, aware of the role of metacognition or the syllabus of the course is so overloaded you are/ one is busy with covering the subject rather than making sure that the students have really picked up the required skills and knowledge. So what does instruction metacognition, what does it do? It helps developing a repertoire of thinking and learning skills.

If you keep asking the few questions while students are solving problems by what is called metacognitive inventory in the literature people have developed a variety of metacognitive

inventories one can pick up elements from those inventories and do a little bit of survey at the time of doing an exercise. Based on that the teacher can give appropriate feedback to the students.

Instruction metacognition fosters confidence and independence in the classroom. Encourages students to self-regulate their learning. Improves decision-making and goal setting skills; Enables students to self-assess the quality of their thinking; Helps to decide which strategies to use in which learning situations; Strengthens essential skills and employability skills. In fact this instruction should be given dominantly in the first few semesters of a undergraduate program.

If they are given early especially in the first year, it will have a great impact on all their learning in the following semesters. And this should be incorporated, this part of instruction metacognition should be incorporated in a preplanned way in several courses in the first and second semesters.

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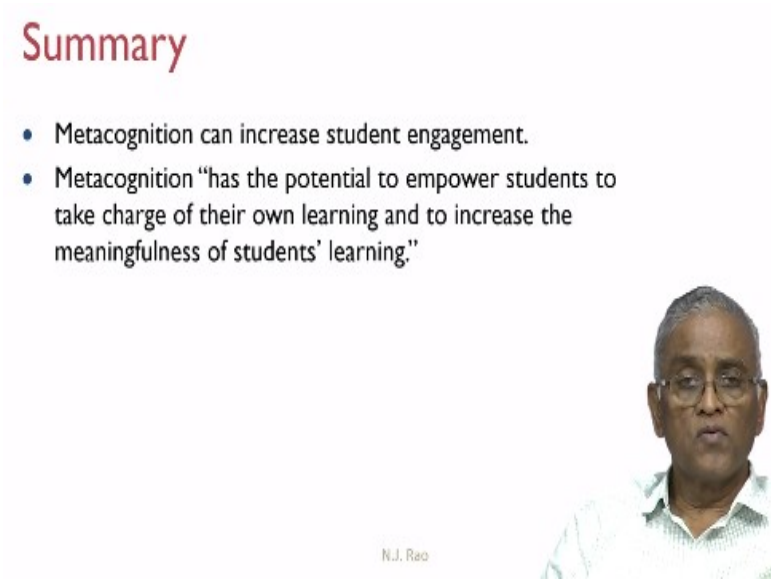

Now in summary, what do we, what do we say metacognition can increase student engagement. What is student engagement? Student is engaging with the knowledge he is expected to learn and engagement is the one that is necessary for, engagement is not mere listening to the lecture given by the teacher. He has to engage with the knowledge. That is either discussing with peers or solving the problem or doing a project related to that or exploring that subject further.

And the metacognitive skill will help in increasing the student engagement. And also it has the potential to empower students to take charge of their own learning and to increase the meaningfulness of students learning. So as one can see it can play a dominant role if one has good metacognitive skills; yes, he can/ he will engage better with the subject matter or he can also direct his own learning. To that extent it is particularly of importance in what you call weaker students.

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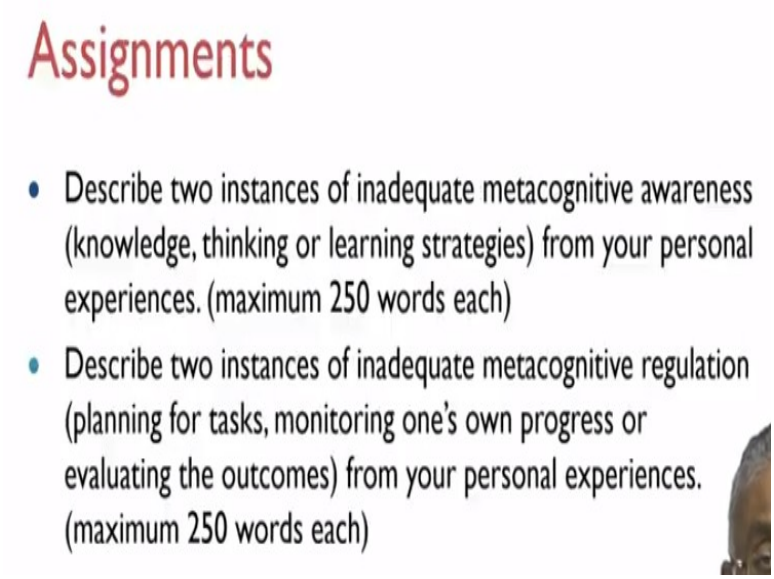

Now the assignments. We ask you to do two. Describe two instances of inadequate metacognitive awareness that is knowledge, thinking or learning strategies from your personal experiences. Write two instances, maximum 250 words each. And I am sure as a teacher you would have faced some students not being aware of their own level of knowledge.

Similarly, describe two instances of inadequate metacognitive regulation; planning for tasks, monitoring one's own progress or evaluating the outcomes from your personal experiences. One your experience may not be focused on metacognition because metacognition our experience shows that it is a new word to majority of the teachers but the implication you will certainly understand when you start attempting to identify your own experiences where students had this metacognitive difficulties.

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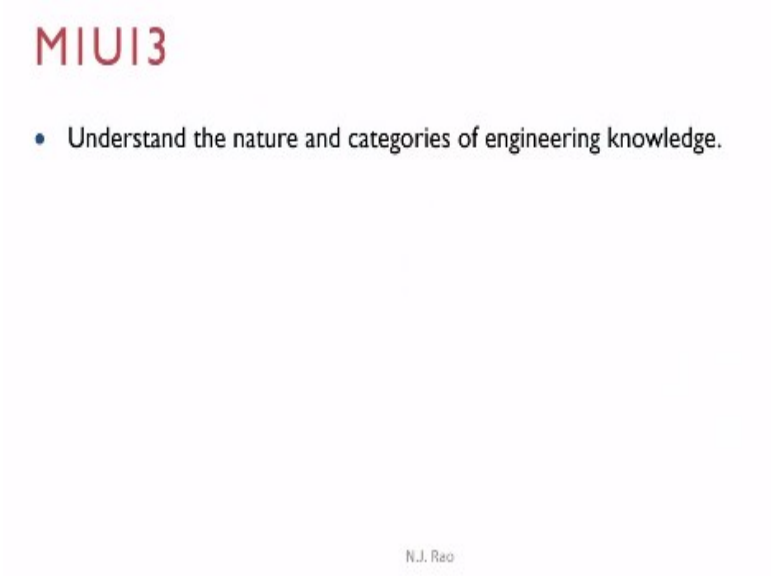

And in the next unit, we will try to understand the nature and categories of engineering knowledge. Thank you very much for your attention.