Teaching and Learning in General Programs (TALG)
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Lecture – 10
General Categories of Knowledge

Greetings, welcome to unit 10 of module 1 of TALG - Teaching and Learning in General Programs.

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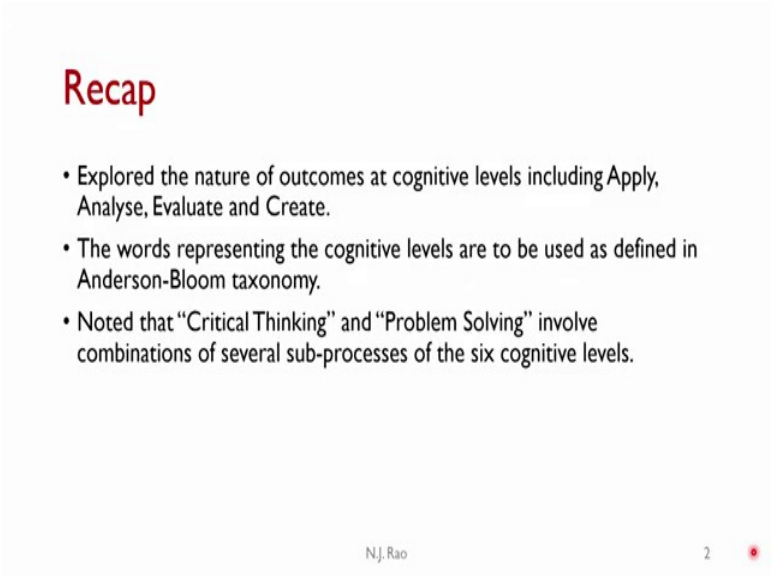

In unit 9, we explored the nature of outcomes in cognitive levels including apply, analyze, evaluate and create. We also noted the words representing the cognitive levels are to be used as defined in Anderson-Bloom taxonomy. So, henceforth we request all the teachers, because education is our business, to use words like understand, analyze, evaluate, create strictly as defined by Anderson-Bloom taxonomy. We also noted that "Critical Thinking" and "Problem Solving" involve combination of several sub processes of the six cognitive levels. We noted each cognitive level has several sub processes. So, critical thinking involves some combination and in some sequence, the sub processes that come under the six cognitive levels that is the one that need to be remembered.

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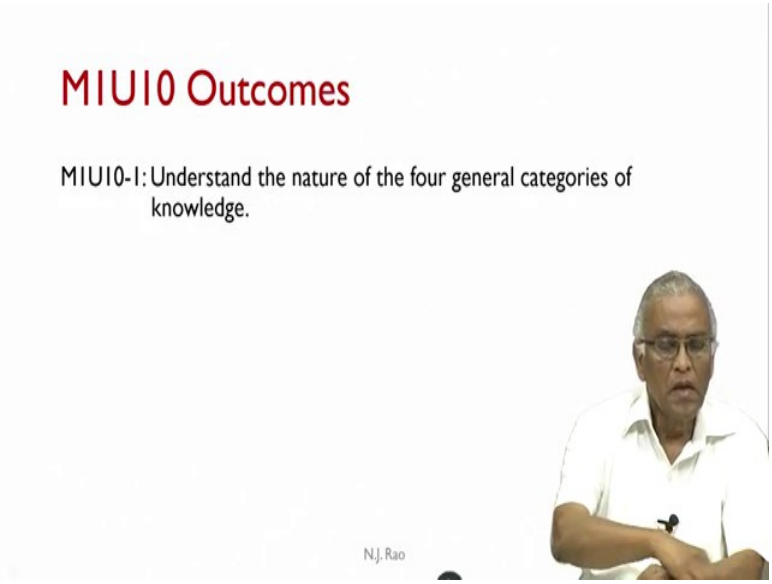

Now, in unit 10, we try to understand the nature of the four general categories of knowledge. We have already mentioned that the cognitive domain is characterized by two dimensions; one is cognitive processes, the other is categories of knowledge.

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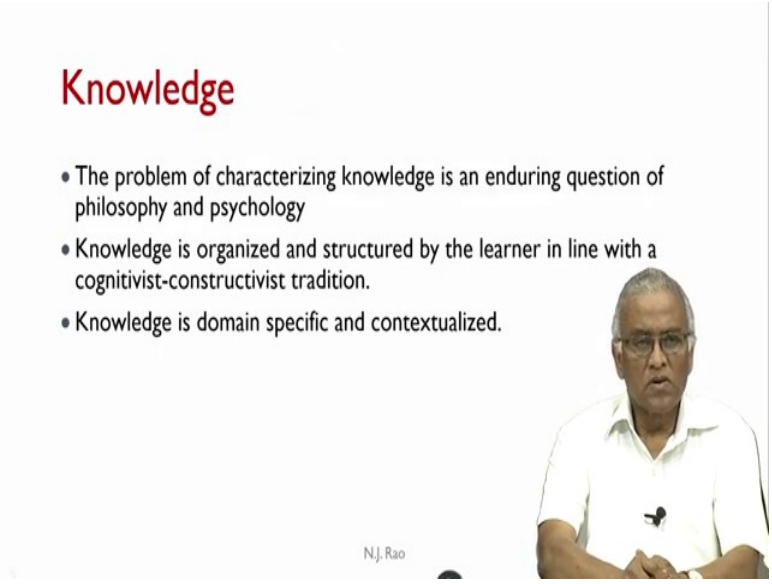

The moment you come to a word like knowledge, it is like several other words in English, we are comfortable in using these words until somebody insist you to define. The moment you ask what is knowledge, and you try to explain, everyone will have an issue with that. Whereas we seem to be comfortable when we listen to the word

knowledge used in any sentence or feel comfortable when I use the word knowledge, but maybe we have some implicit definition which we normally are very reluctant to even articulate. And it is understandable, because the problem of characterizing knowledge is an enduring question of philosophy and psychology, specially philosophy for the past several 1000 years. Even today, there is no commonly agreed definition of what constitutes knowledge and what constitutes what is called true knowledge.

Knowledge is organized and structured by the learner, now in our context what we call cognitivist-constructivist tradition. We will not again elaborate what this cognitivist and constructivists definition is, but that's the background from which we are now classifying or categorizing knowledge.

Now, one thing is true, we will also accept that knowledge is domain specific and is contextualized. So, what constitutes knowledge today, may not be considered knowledge after sometime. We do not know about it; we do not guarantee that the same thing will be considered as knowledge after let us say a decade or so.

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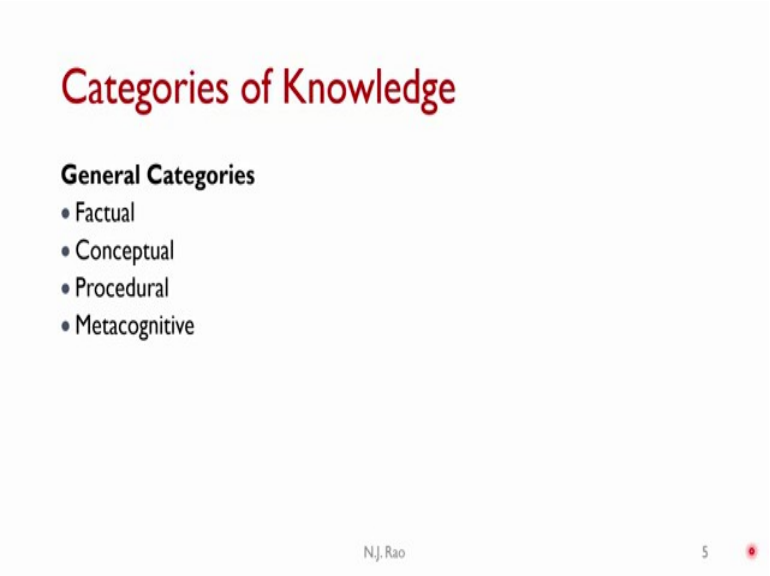

There are four categories of knowledge which are applicable across all disciplines, including all the professional courses/professional programs. We call them as factual, conceptual, procedural and metacognitive.

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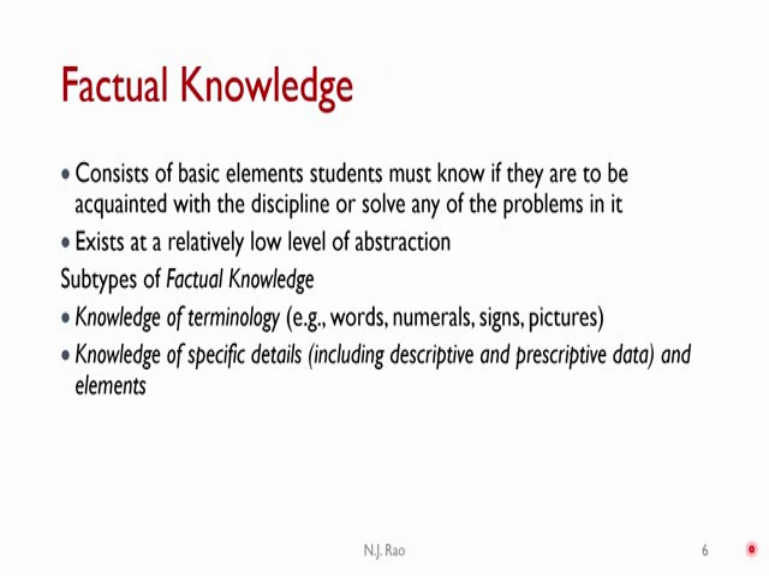

Let us look at these four categories of knowledge. The first one is factual knowledge - which is fairly simple to understand- consists of basic elements students must know if they are to be acquainted with the discipline or solve any of the problems in it and this knowledge exists at a relatively low level of abstraction. For example, what are the sub types of factual knowledge? Knowledge of terminology; that means, we use certain words, numerals, signs, some symbols and some pictorial representation in one specific way in a given discipline.

So, to that extent, it is a terminology. So, one has to be familiar with the terminology. When I use a word like force, force is a word right. So, I am always using that in the same context. knowledge of specific details- including descriptive and prescriptive data. Descriptive means ‘what is?’ something weighs so much. The density of certain material is so much -that is descriptive data. The prescriptive data would mean you are saying it should be so much, I am prescribing. So, both descriptive and prescriptive data belong to the category of factual knowledge.

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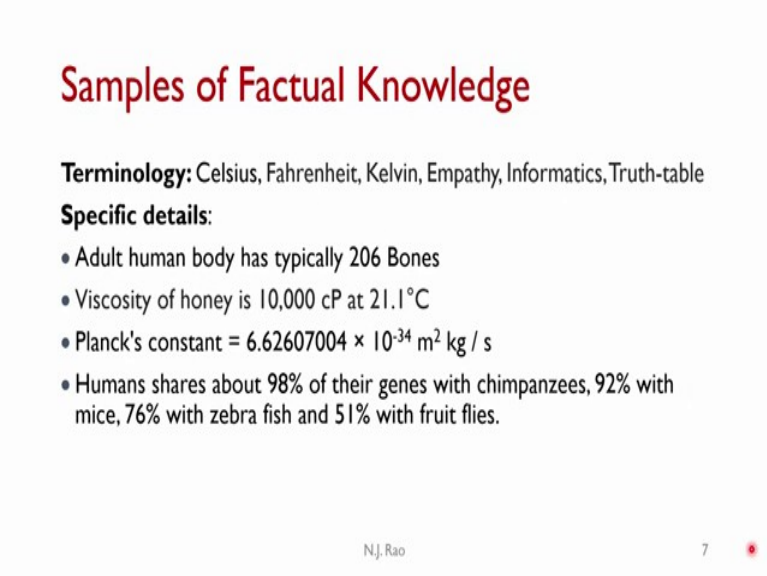

Now, terminology examples if you look at - Celsius, Fahrenheit, Kelvin, Empathy, Informatics, Truth-table: these are some of the words. I think in every subject you can list a large number of such terms which are specific to that course. More specific details like- adult human body has 206 bones, Viscosity of honey is 10,000 cP at 21.1 degree centigrade, Planck's constant is something 6.626 and odd multiplied by 10 raised to be minus 34 metric square kg per second, Humans share about 98 percent of their genes with chimpanzees, 92 percent with mice, 76 percent with zebra fish and 51 percent with fruit flies. These are factual information and that is it.

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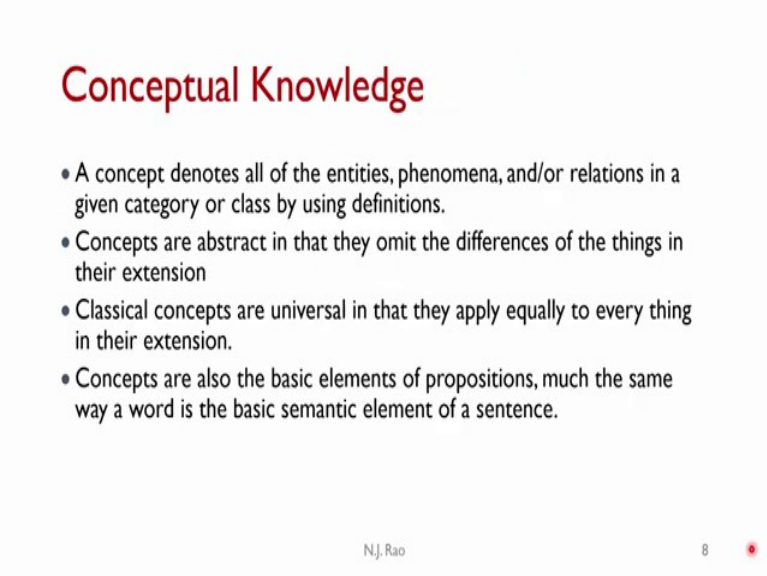

Now, come to a little more difficult one. while everyone seems to be very comfortable saying that concepts are very important; every subject has so many concepts, I always found when somebody's pinned down to define 'concept', they have some difficulty.

Now, let us look at a formal definition of concept, "a concept denotes all the entities, phenomena and are relations in a given category or a class by using definitions". Now in abstract way; if you look at it, you collect a set of elements and you are giving a label to that and I have some mechanism by which given any element, I should be able to determine whether it belongs to this group or not. Let us take an example of a concept. For example, take a very simple thing like a tree; tree is a concept, but tree if you look at all the entities that can be considered as trees; that means, we are willing to ignore all the differences between individual species of trees. You have a mango tree, you have a coconut tree, you have some other tree, but we call all of them as trees.

So, that entity if you want to call it the tree is a kind of a concept. But now even with respect to trees, I can call something as a mango tree. But once again when I call mango tree as a concept, I am willing to ignore the differences between different types of mango trees that I have. So, I am grouping a set of elements called mango trees and calling it as a label called mango tree. So, this can go on and similarly if you take the concept of leaf, then I can recognize something as a leaf, but all leaves are not the same.

So, in some sense I have certain properties that satisfy something to be called a leaf. So, one can try the other concepts like we try defining a chair; chair is a concept or you can take a thing like a common object like cup; cup is also a concept because there are so many types of cups; when we go to the shop all of them we call them as cups.

You try defining simple concepts like chair or a cup. As we just now stated, concepts are abstract in that they omit the differences of the things in their extension. Like if you talk something about a cup. When I see a cup I am able to identify as a cup because two cups may be very different from each other in terms of their shapes, colors, you have a whole bunch of things or sizes and so on and yet we are able to identify them as belonging to the same category called cups.

And classical concepts are universal, in that, they apply equally to everything in their extension. And one should also look at concepts are also the basic elements of propositions, much the same way a word is a semantic element of a sentence. So, how do

you form a sentence? You have several words and you put them together as per certain rules and then it becomes a sentence, but first you must have words. So, concepts are like words, and then I can start putting two or more concepts together to form what we call it a principle; that means, a principle is putting two or more concepts together to make certain sense.

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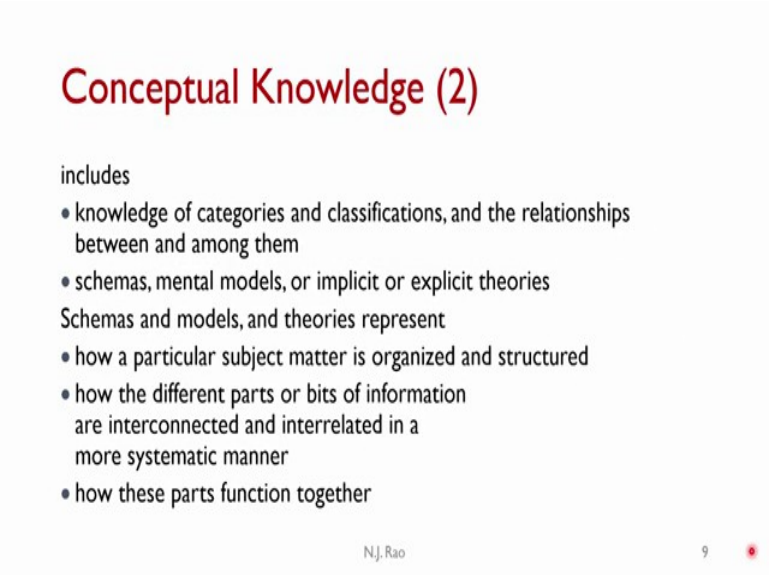

For example, force is a concept, mass is a concept, acceleration is a concept, but when I say F = ma it becomes a principle or a law and that is what we have been looking at. To that extent when I say force equal to mass multiplied by acceleration and I made a sentence, but I corrected three concepts together and now it becomes a law or a principle. But we are still even going further up for example, conceptual knowledge includes knowledge of categories and classifications and the relationships between and among them; that is what we are calling principles.

Sometimes we are also calling schemas or mental models or implicit or explicit theories if you have. For example, Newton's laws of motion; that means, three laws you put together and you give a label to that. So, you can call it a mental model or you can call it a schema.

So, schemas, models and theories represent how a particular subject matter is organized and structured. You take any subject. So, even to communicate with each other, you identify certain concepts, give them a label and precisely you give a definition to each

word that you chose and you say how these words are related with respect to your subject matter and that becomes a schema or a model for you.

So, conceptual knowledge includes how different parts or bits of information are interconnected and interrelated in a more systematic manner and how these parts function together. This is all the conceptual knowledge.

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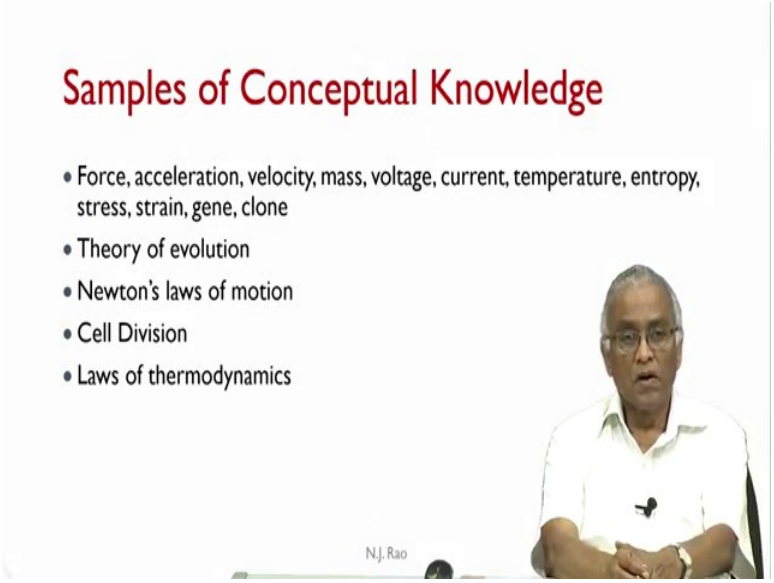

Now, samples of conceptual knowledge; force, acceleration, velocity, mass, voltage, current, temperature, entropy, stress, strain; density, gene, clone, you can list any number of such concepts from all subjects or you can call about a theory: Theory of evolution, Newton's laws of motion, cell division, laws of thermodynamics. These are all the conceptual knowledge, I would call it hierarchy, but they are things put together. Some principles put together becomes laws, or a theory, or a model or a schema. So, this is what we call as conceptual knowledge.

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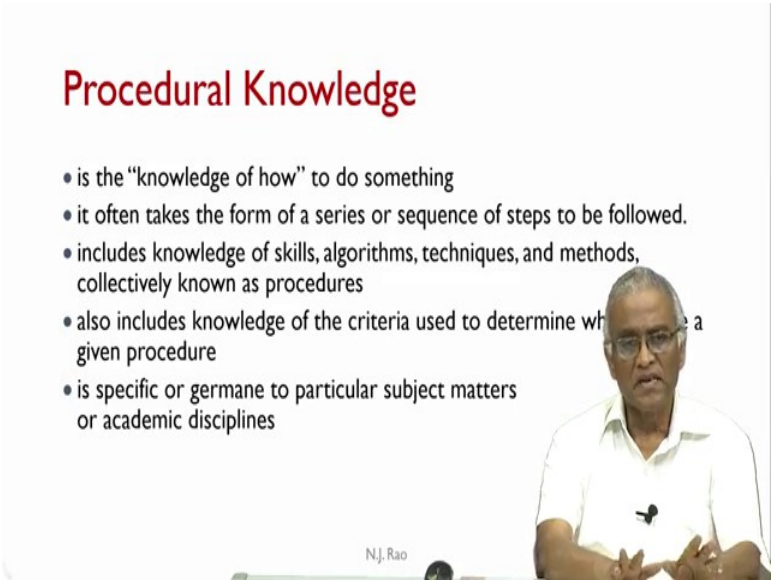

Now, procedural knowledge is fairly simple to understand. It is the knowledge of how to do something. It often takes the form of a series or a sequence of steps to be followed. Now procedural knowledge will include skills, how something is to be performed, algorithms, techniques and methods, collectively known as procedures. Also includes knowledge of the criteria used to determine when to use a given procedure. Not only the procedure, but knowledge of criteria used to determine when to use the procedure. It is specific or germane to a particular subject matter or academic disciplines. A particular procedure that a subject involves may not be applicable in some other subject because the acceptable procedure is somehow collectively decided with respect to that subject matter by people working in that area.

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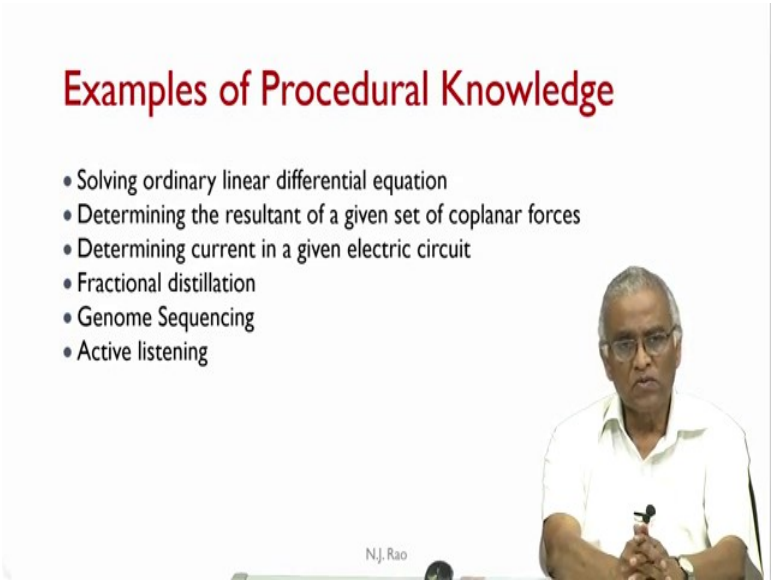

Examples of procedural knowledge: solving ordinary differential equation, determining the result of a given set of coplanar forces, determining current in a given electric circuits, fractional distillation, genome sequencing or simply in English active listening. These are all examples of procedural knowledge.

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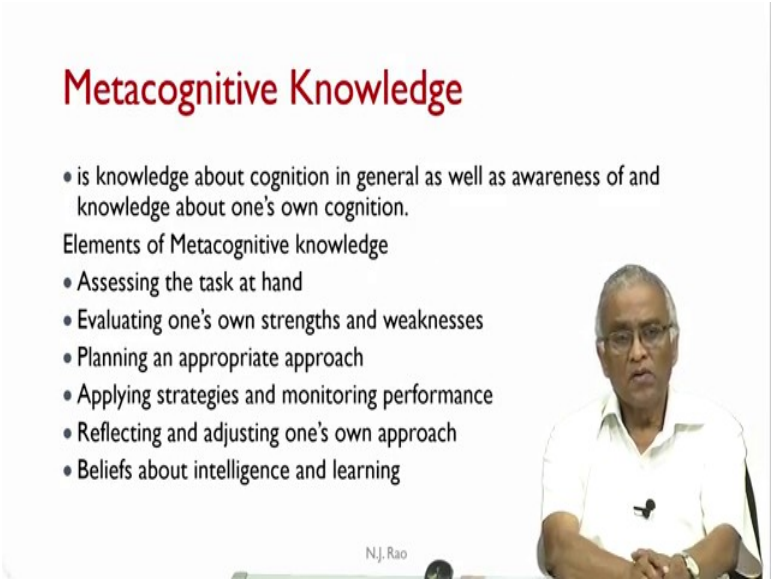

Now, you have metacognitive knowledge. We will have occasion to explore this category of knowledge more in detail in the following unit, but metacognitive knowledge, the fourth category that we talked about is knowledge about cognition in

general as well as awareness of a knowledge about one's own cognition. That is why we call it Meta, that is you are trying to know about your own cognition.

Now, we can give some samples as we said we will deal with it more in detail in a later unit. Elements of metacognitive knowledge; for example, when a task is presented accessing the task at hand, not everyone can do the same way are equally fast or correctly. To that extent the metacognitive knowledge- that is ability to assess a task at hand, Evaluating one's own strengths and weaknesses - cognitive weaknesses, and planning an appropriate approach, "how do you I the problem?" Applying strategies and monitoring performance. Can I apply a strategy to learn something and can I monitor my own performance how well I have learnt? Reflecting and adjusting one's own approach, beliefs about intelligence and learning. These are some elements of metacognitive knowledge and this knowledge this metacognitive knowledge greatly can differ from one learner to the other, we will see the implications of that.

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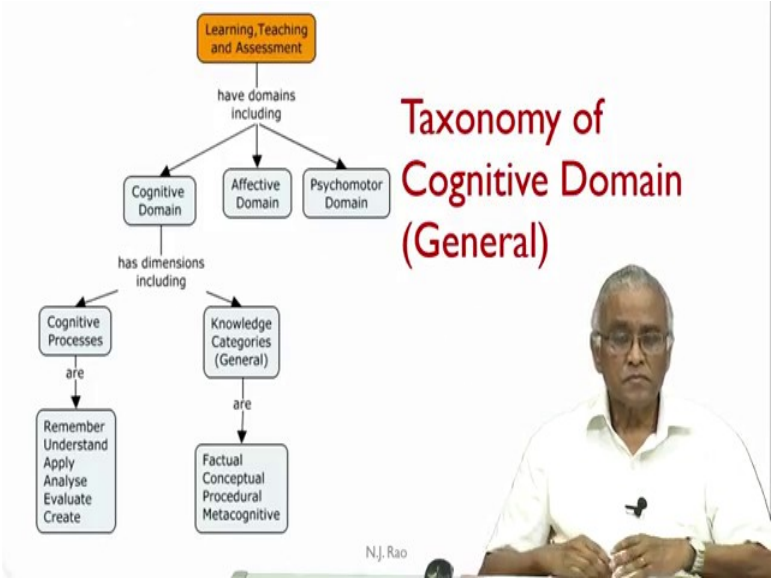

Now, one can capture the taxonomy of cognitive domain- General- we are not yet looking at affective domain and psychomotor domain, we will do that in later units.

But as of now learning and teaching and assessment have domains including cognitive, affective and psychomotor , and what we have seen is cognitive domain has dimensions - cognitive processes and knowledge categories, and why we call it general? These four categories of knowledge are considered common across all types of activities, but I can

have additional categories of knowledge in subjects like engineering. Because there are in fact, other categories of knowledge which are specific to engineering as we are not dealing with that we call them as general categories. But these four categories are common to any subject of concern.

Then the cognitive processes are the 6. So, the taxonomy of cognitive domain can be captured; in this tool used called concept map. It can be captured in that.

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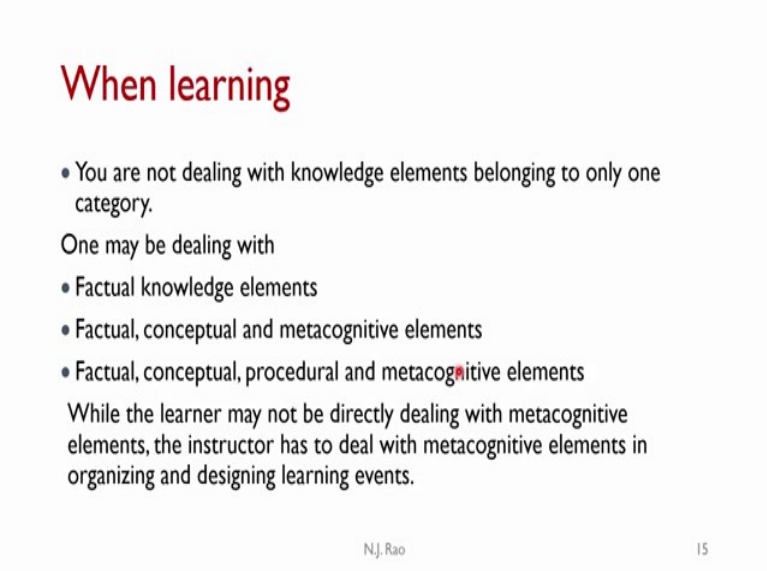

When you are learning, you are not dealing with knowledge elements belonging to only one category or one piece of knowledge. So, one may be dealing with purely factual knowledge elements or factual, conceptual and metacognitive elements or factual conceptual, procedural and metacognitive elements. so, it depends on the particular object of learning or particular learning activity, while the cognitive process is identified, the knowledge elements can be multiple.

Another interesting thing is while the learner may not be dealing with metacognitive elements, the instructor has to deal with metacognitive elements in organizing and designing learning events. So, the metacognitive elements are very important to the instructor; because as he's designing learning events- instruction it becomes important. And again how much attention one needs to pay to metacognitive elements will depend on the kind of learners that a teacher has in the class.

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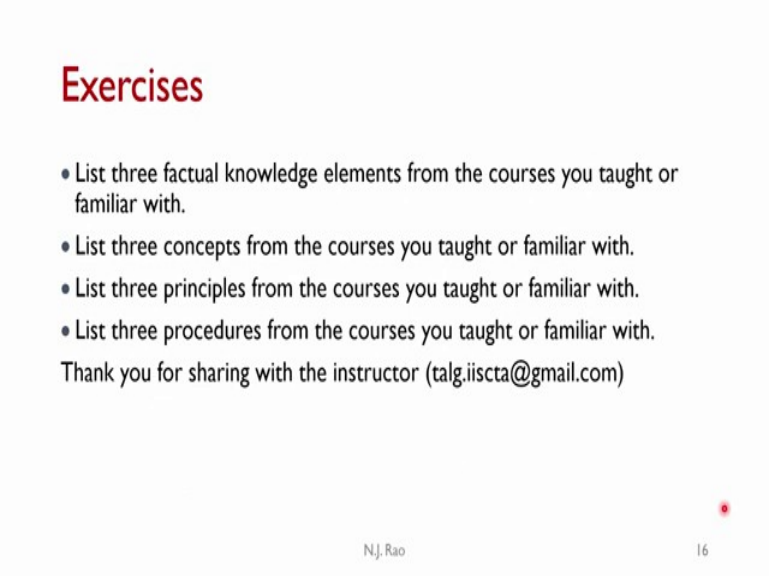

Now, coming to a few exercises, we would like you to:

List three factual elements from the course you taught or familiar with. List three concepts from the courses you taught or familiar with and in the same category List three principles from the courses you taught or familiar with or List three procedures from the courses you taught or familiar with.

Thank you for sharing with the instructor.

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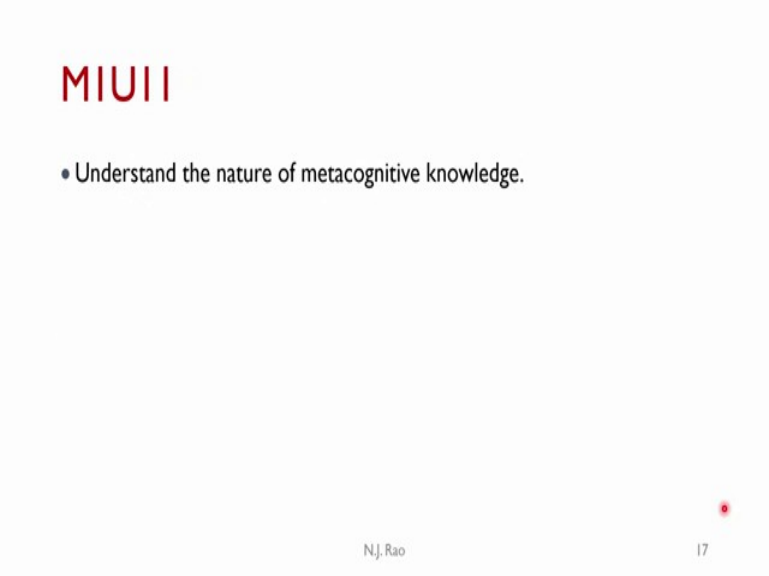

The metacognitive knowledge requires a little more attention, we will spend more time in understanding the nature of metacognitive knowledge in the unit 11.

Thank you.