Teaching and Learning in General programs (TALG)
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Lecture – 09
Cognitive Levels 2

Greetings, welcome to unit 9 of module 1 of TALG, Teaching and Learning in General programs. Today we deal with some more Cognitive Levels after the earlier cognitive levels we looked at.

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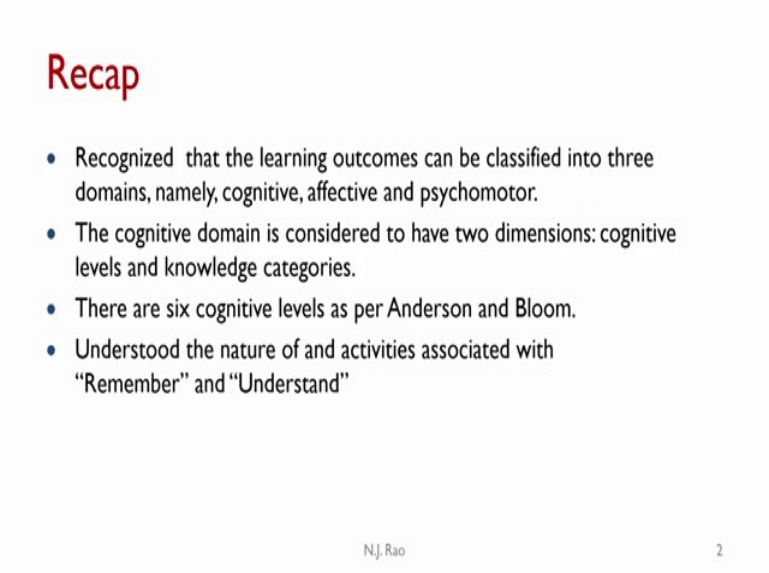

We recognized that learning outcomes can be classified into three domains namely cognitive, affective and psychomotor. The cognitive domain is considered to have again two dimensions: cognitive levels and knowledge categories. There are six cognitive levels as per Anderson-Bloom taxonomy. We made a list of them and out of the six we considered the first two cognitive levels namely 'remember' and 'understand' and we looked at the nature and the kind of activities that are associated with these two cognitive levels.

Once again, I should bring to your attention that any taxonomy is only a convenient way of classifying learning activities, there is no like any absoluteness about it. So to the extent Anderson-Bloom taxonomy is one of the taxonomies. As I mentioned earlier there are other taxonomies and somehow the Anderson- Bloom taxonomy has been found

more acceptable to much larger number of people and it has withstood the criticism for about 60 – 65 years since its proposal in 1956.

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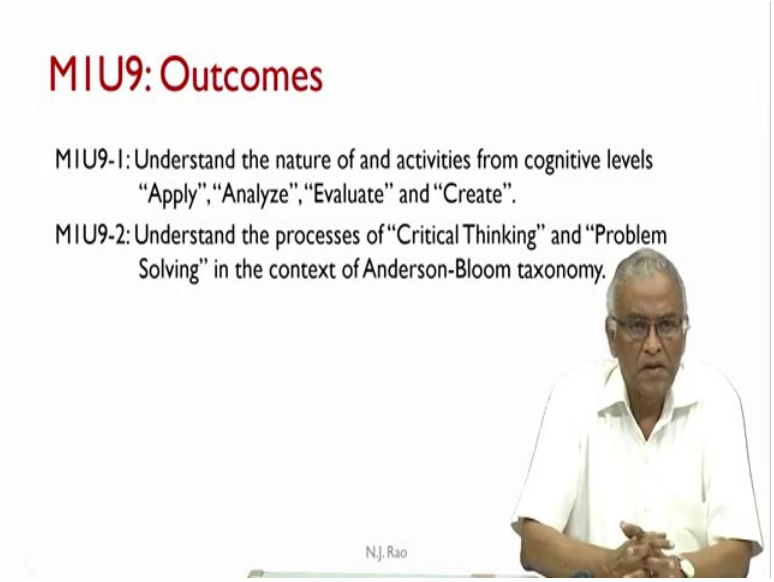

Now, in the unit 9 the expected outcomes are understand the nature of and activities from the cognitive levels ‘apply’, ‘analyze’, ‘evaluate’ and ‘create’. These are the next four cognitive levels. And, also understand the processes of critical thinking and problem solving in the context of Anderson-Bloom taxonomy. Why do we require this? Anderson -Bloom taxonomy does not identify critical thinking and problem solving as independent, separate cognitive levels.

So, one need to understand what these cognitive processes in relation to the six cognitive levels of the Anderson-Bloom taxonomy.

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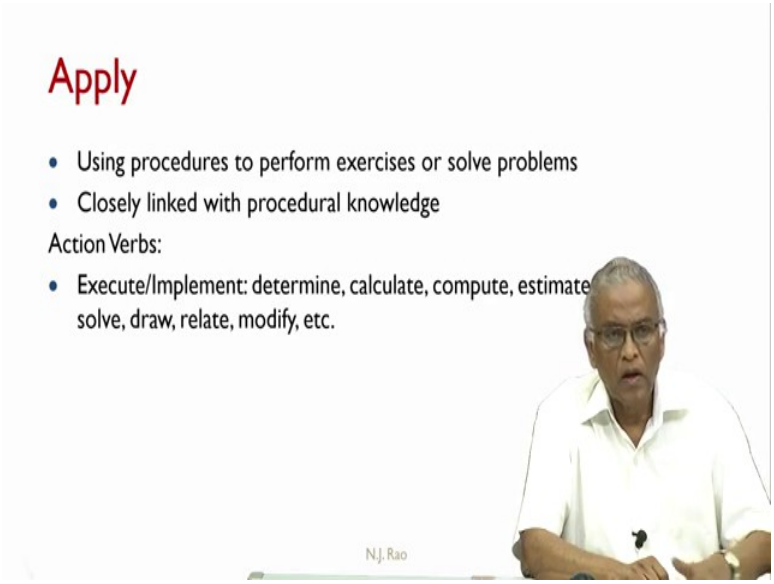

Now, the third cognitive level in the Anderson-Bloom taxonomy after remember and understand is ‘apply’. Apply is a very simple process to understand, we use some procedures to perform exercises or solve problems. When we solve a problem, we give a series of steps and one must be able to perform those steps; that is application and it is also closely linked with what we are going to consider later the procedural knowledge.

And, now there are two sub-processes under apply. One is execute, the second one is implement, but for both of them the action verbs include determine, calculate, compute, estimate, solve, draw, relate, modify, etcetera. There can be many more action verbs be proposed. And if you look at the action verb ‘draw’, it appears both in remember as well as understand. So, the role of whether it belongs to a particular cognitive level or not should be decided based on the context.

So, as you can see some action verbs can be common across multiple cognitive levels and one need to understand in a given context rather than say draw is always associated with such and such cognitive level; we cannot make such statements.

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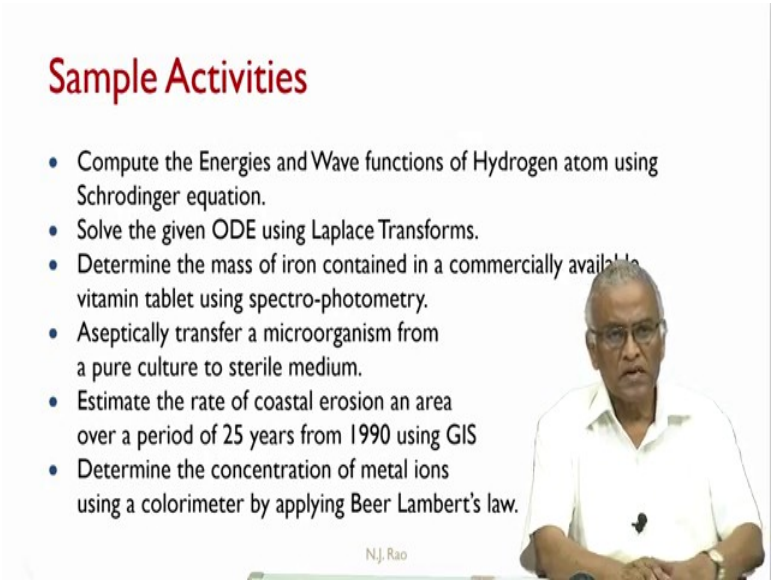

Let us look at some sample activities from different subjects, like: compute the energies and wave functions of hydrogen atom using Schrodinger equation. Now, there are two parts in this, you are computing the energies and wave functions of hydrogen atom, I can also state merely that, but I put an additional condition- using Schrodinger equation; that means, the learner has to compute only using Schrodinger equation. It is an advantage or disadvantage for some.

In the sense the student does not have to make a decision- which particular method that he needs to use to compute or if he's not familiar with Schrodinger equation and if he's forced to do that, obviously it will become a disadvantage. We will come back to this. where you do not specify the condition it becomes what we call implement, we call that sub processes implement. That means, the learner has to make first a decision which particular process to be used and then apply that process. Whereas in this particular case, we call it execute. It comes under the category of execute where he does not have to make a decision which particular process that he has to use to compute the energies.

Other examples: solve the given ordinary differential equation using Laplace transform. It is the same story; if I remove the condition using Laplace transform it becomes implement, if I add this condition it becomes execute. Determine the mass of iron contained in a commercially available vitamin tablet using spectro-photometry, it is a same kind of thing. Aseptically transfer a microorganism from a pure culture to sterile

medium. If you look at this one and the previous activity are mainly laboratory based activities. They will also come under the category of apply. You are not doing this on a piece of paper or using a paper and pencil. You are using some equipment and performing some activities to determine or to do some operation like transferring.

Other examples: estimate the rate of co erosion in an area over a period of 25 years from 1990 using GIS. This will be an activity that is related to course in geography. Determine the concentration of metal ions using a colorimeter by applying Beer Lambert's law. So, these are some sample activities that belong to the category of apply.

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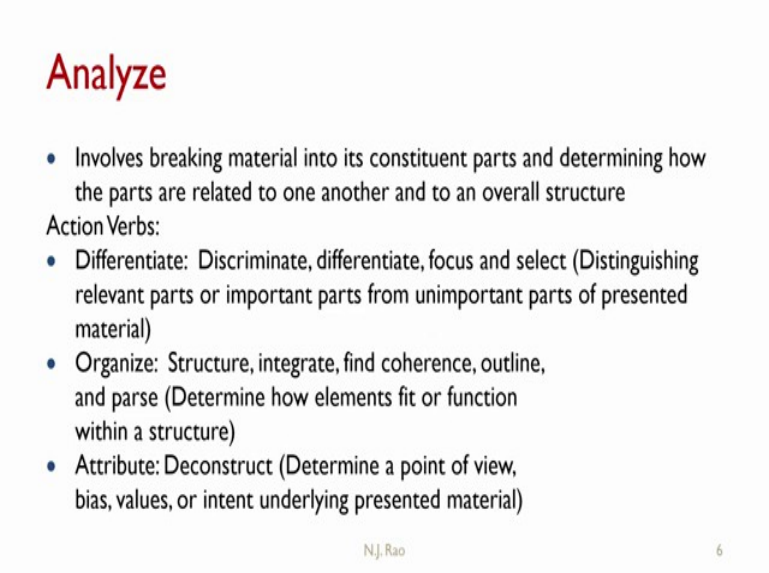

But, as you can see you have plenty of such activities in sciences especially, all sciences or mathematics courses will have many apply activities.

Coming to the next cognitive level namely 'analyze'; a word of caution with regard to cognitive process analyze. Because analyze is a word that all teachers practically all people used today in some kind of a commonsensical way and with somewhat loose meaning because in many courses we use the word analyze or evaluate, calculate, sometimes even the word design - all these words are used in interchangeable manner. But if you decide to use Bloom's taxonomy, it is necessary to use the word analyze only in this particular way as it is defined here. So, there was nothing wrong in using the word analyze in the previous sense, but once you come into this realm of Bloom's taxonomy it is necessary to give the meaning to this word analyze the way it has been stated here.

So, analyze involves breaking material into its constituent parts and determining how the parts are related to one another and to an overall structure. There are several elements in this which we will presently see. There are three sub processes in this, one is ‘differentiate’, the other is ‘organize’, the other is ‘attribute’. For example, some verbal description is given to you and the differentiate process means you are discriminating, differentiating, focusing or selecting something.

That means, in the given description you are trying to identify different parts first and again in different parts you are considering something that is relevant or not relevant to the main question that your addressing or some more important some are less important in the presented material. When you are differentiating among the elements that are presented in a description to you that is the sub process we are calling differentiation and that is an analysis process.

Then the next thing is you are now trying to explain how the elements fit or function within a structure. So, you are organizing the information now that is presented to you in a description. You are either structuring, integrating, finding coherence, outline and parse. For example, you are trying to relate the various elements in different ways. Then the third sub process is attributing, that is what we call deconstructing like a given description you can ask what is the point of view that is being presented or with what bias it is being presented; what values it is emphasizing; what is the intent underlying the presented material. So, these are what we call attributing. This is also another sub process of analysis. If you do any of these three we call that cognitive process as analyze.

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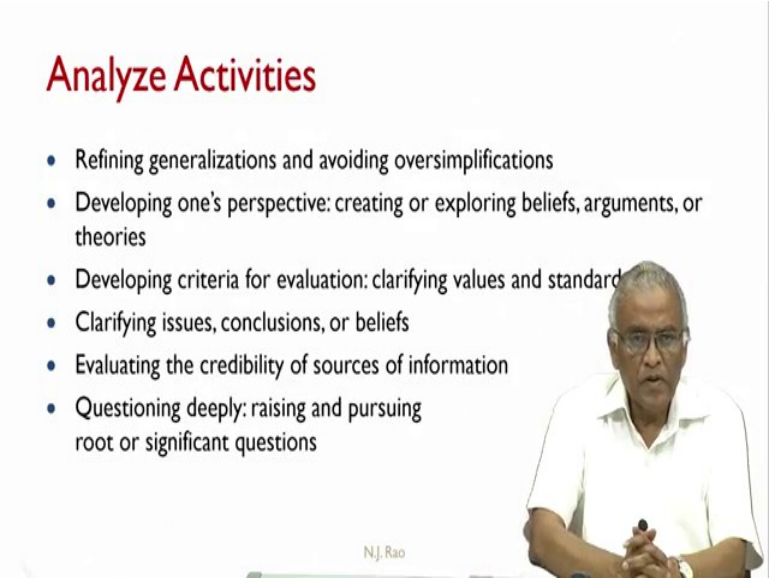

Now, some generic type of analyze activities: Refining generalizations and avoiding oversimplification. For example, all of us are prone to generalize very readily from our personal experiences or merely reading some small amount of material; let us say either in a book or in a newspaper. We immediately generalize and it is equivalent to over simplifying or you are generalizing where you do not have any business to do so because the presented information is not adequate to generalize.

And, the next thing is developing one's own perspective, creating or exploring beliefs, arguments or theories; that means, whenever I present my point of view, prior to that I need to explore my beliefs or my arguments or my theories. Or similarly in a presented material you are exploring believes or arguments. Further developing criteria for evaluation- which means clarifying values and standards, Clarifying issues, conclusions or beliefs, evaluating the credibility of sources of information, questioning deeply raising and pursuing root or significant questions: These are some analyze activities.

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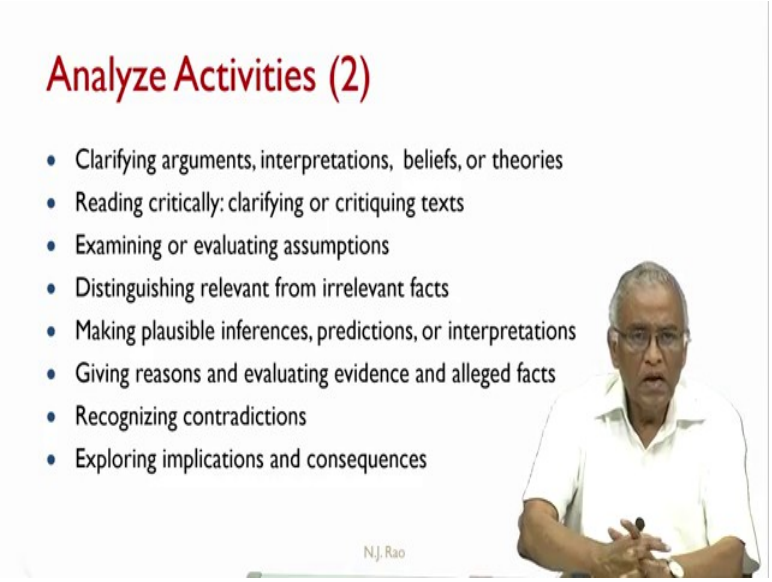

Further clarifying arguments, interpretations, beliefs or theories; Reading critically: clarifying or critiquing texts, Examining or evaluating assumptions, Distinguishing relevant from irrelevant facts, Making plausible inferences, predictions, or interpretations, Giving reasons and evaluating evidence and alleged facts; recognizing contradictions; exploring implications and consequences. All these activities are not completely independent of each other. Many of them overlap with each other in terms of their intent, but these are some type of activities that one is required to perform under the cognitive level analyze.

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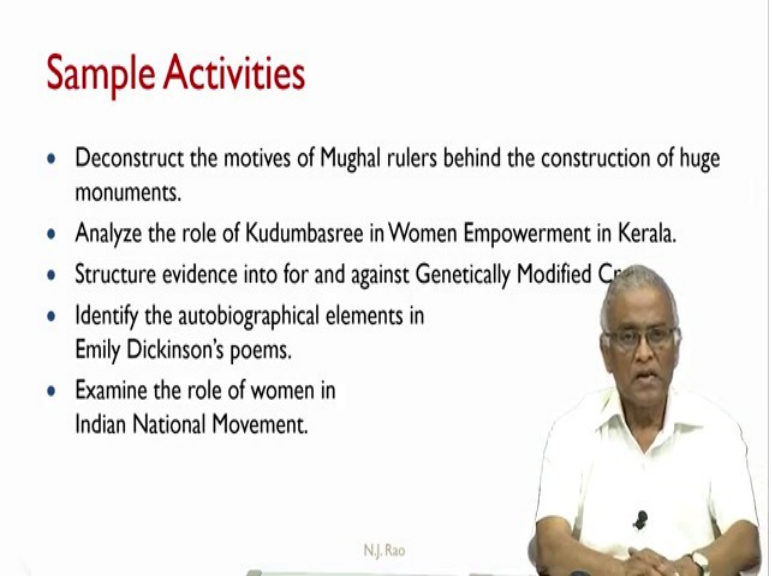

Let us actually give example from some of the subjects that we deal with: Deconstruct the motives of Mughal rulers behind the construction of huge monuments, Analyze the role of Kudumbasree in women empowerment in Kerala, Structure evidence into for and against Genetically Modified Crops, Identify the autobiographical elements in Emily Dickinson poems, Examine the role of women in Indian National Movement.

For many of these questions we can prepare a predetermined answer or for some there can be one particular way presented in the textbook and if you can reproduce, while the nature of the question may look like belonging into analyze but in actuality it will become merely remembering the answer and reproducing it and that will happen with all types of questions namely if the question is predictable and if you already know the answer for a set of questions, then you have effectively transferred the whole thing all questions irrespective of way it is stated to the category of remember.

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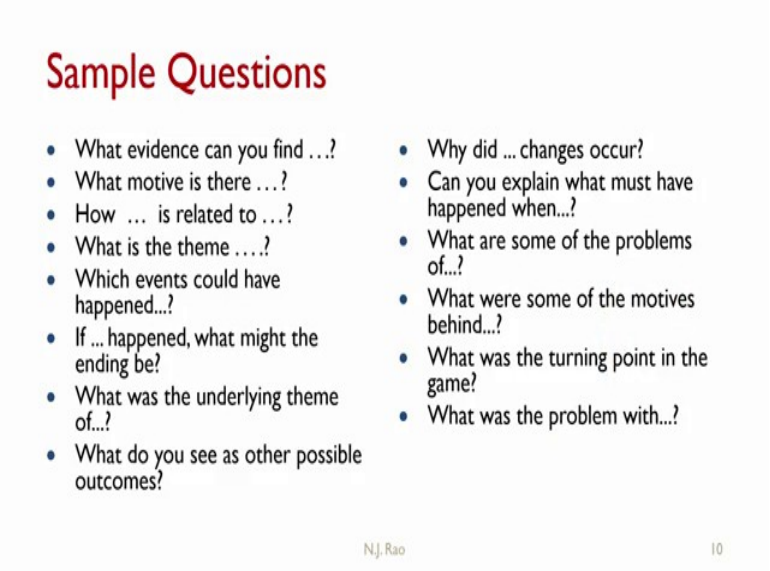

Now, these are some generic type of questions belonging to the category of analyze. What evidence can you find…? What motive is there…? How … is related to …? What is the theme in the presented material…? Which events could have happened in this…? If such and such thing happened what might the ending be? What was the underlying theme of…? What do you see as other possible outcomes…? Why did such changes occur? Can you explain what must have happened when…? What are some of the problems of…? What were some of the motives behind…? What was the turning point in

the game? What was the problem with…? So, one can use this kind of generic questions and fill in the details with respect to one's own subjects.

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Now, we come to the next cognitive level, namely evaluate. Evaluate - this word is also used in a commonsensical manner, but here we have a very specific meaning for evaluate. Evaluation is making judgment based on criteria and standards that is where you are making judgments, but these judgments are not ad-hoc, but they are based on criteria and standards. These criteria that we use can include like a used include quality, effectiveness, efficiency, consistency. You can have several such criteria that we can have. Similarly, the standards may be either quantitative or qualitative.

So, when you are making a judgment, one may have to deal with only one criterion. In that case it becomes very simple. But in many cases we may have multiple criteria. And again there are two sub-processes in this: check and critique; check is testing, detecting, monitoring and coordinating whereas in critiquing you are judging. Now, what do you judge? accuracy, adequacy, appropriateness, clarity, cohesiveness, completeness, consistency, correctness, credibility, organization, reasonableness, reasoning, relationships, reliability, significance, standards, usefulness, validity, values, worth, criteria, and procedures.

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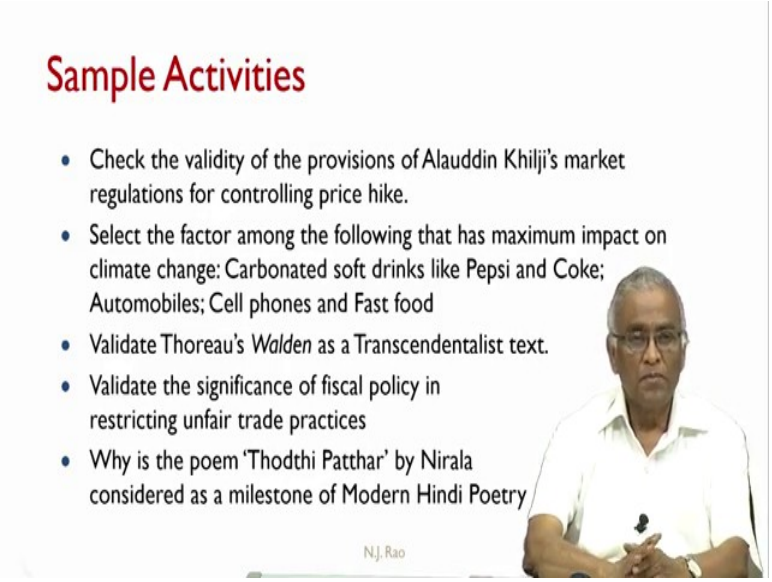

Now, sample activities from some of the general courses: check the validity of the provisions of Alauddin Khilji's market regulations for controlling price hike, Select the factor among the following that has maximum impact on climate change, Carbonated soft drinks like Pepsi and Coke, automobiles, cell phones and fast food. Validate Thoreau's Walden as a transcendentalist text, Validate the significance of fiscal policy in restricting unfair trade practices, why is the poem Thodthi Patthar by Nirala considered as a milestone of modern Hindi poetry.

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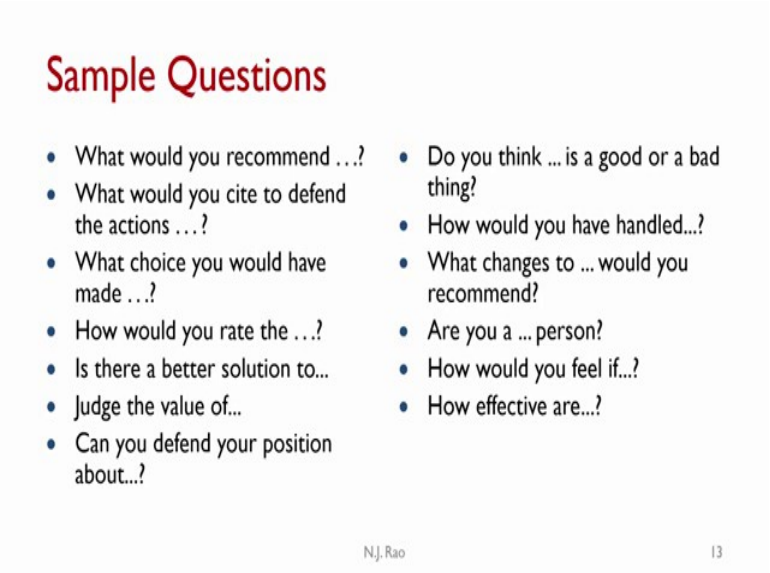

And, again generic questions that come under this are: what would you recommend…? What would you cite to defend the actions…? What choice you would have made…? How do you rate the? … Is there a better solution to…? And judge the value of…? Can you defend your position about…? Do you think such and such a thing is good or bad thing? How would do you have handled…? What changes to such and such thing would you recommend? Are you such and such a person? How would you feel if…? How effective are…? So, these are some sample questions that you can use and relate them to your subjects and you can fill in the dots and you will have a whole bunch of evaluate type of questions related to your subject.

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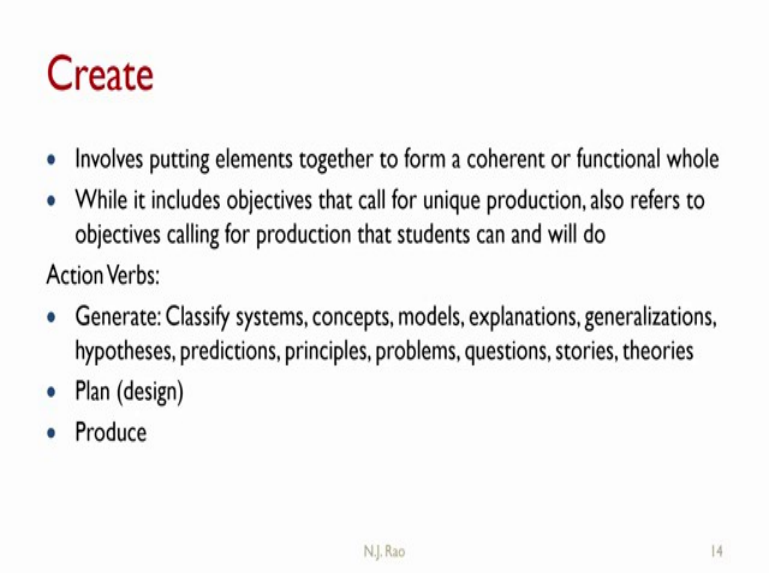

Now, we come to the final sixth cognitive level namely create. Create involves putting elements together to form a coherent or functional whole. It looks vague, but if some elements are there you can put them together something, completely different from what it has been done. let us say I want you to make a chair, your own version of it and I will give you the materials whatever materials you ask for. Chair is not something unknown to us, but still I may be able to put them together in a completely different way. So, I am creating a new structure, new functional whole that is a simple example. While it includes objectives that call for unique production also refers to objectives calling for production that student can and will do.

Now, again there are three sub-processes in this; one is generating or generate, plan, third one is actually produce. Now, generating a simple thing, I can generate a new hypothesis, I can classify given set of objects in completely different way than what is already done, I can classify the concepts; I can classify the models; I can generate a completely new explanation; I can generate a hypothesis; I can predict; I can come out with a new principles and I can even formulate a problem and I can raise new question.

For example, raising questions, generating questions is one of the fundamental activities of any research. If you are able first generate questions and if they are good questions, finding answers for them follows there, but raising the questions is the major step change that you would make. You can also write stories; you can write poems; you can propose theories, all these. These are all what we call generate activities under create.

Now, plan - literal meaning of plan is to draw something that is used as a basis for actually making something; that is you draw a plan for a building, you draw a plan for designing an electronic circuit and electronic product. So, plan or design both mean the same, but the output of design or planning is a complete document to make something and this is where, no two designs, they will be close to each other, but if two learners are asked to design something,

There will be some differences between them to that extent each one is creating something of his own and then from a design when you are producing, you are making something, while making something you are modifying something or you are creating something. So, no two productions will be identical, to that extent you are creating. For example, you are producing a small play. When you are actually translating a script into a play and actually play it, you are producing your own version. So, you are creating something. So, these are the three sub-processes that are involved in the cognitive level create.

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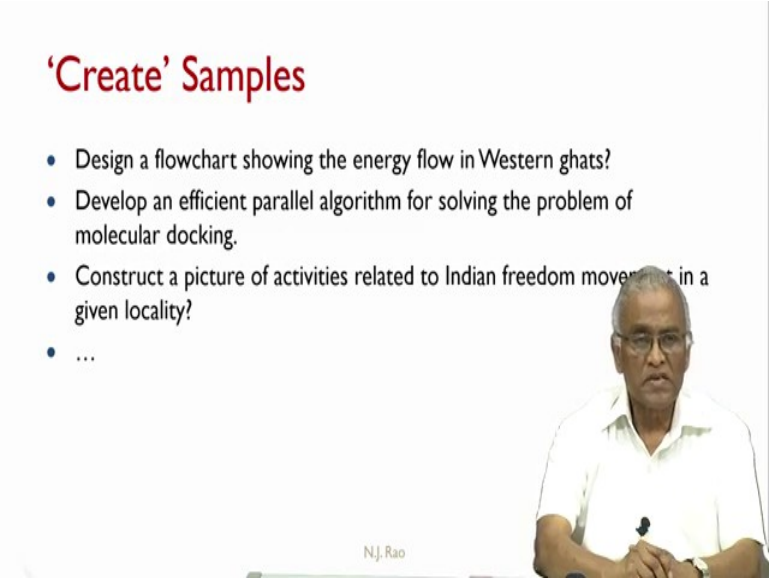

Some examples, design a flow chart showing the energy flow in Western ghats. Develop an efficient parallel algorithm for solving the problem of molecular docking. Construct a picture of activities related to Indian freedom movement in a given locality? So, these are some create samples.

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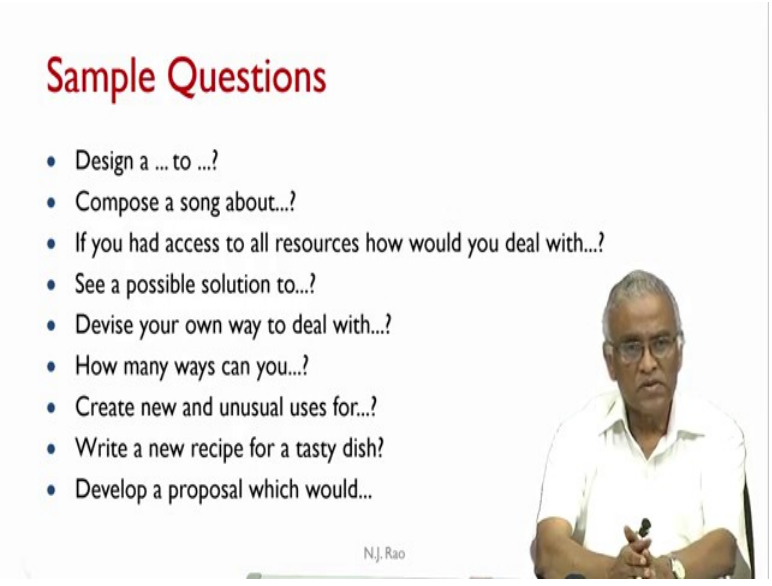

And, sample generic questions. "Design a … to …" and that I think can be applied to any number of subjects that particular generic question. Compose a song about…? Obviously, if you are in any literature, in any language one can ask this question. If you

had access to all resources how do you deal with such in such a thing? See a possible solution to…? Device your own way to deal with…. How many ways can you? Create new and unusual uses for…? Create a new recipe for a tasty dish? Develop a proposal which would meet some requirements.

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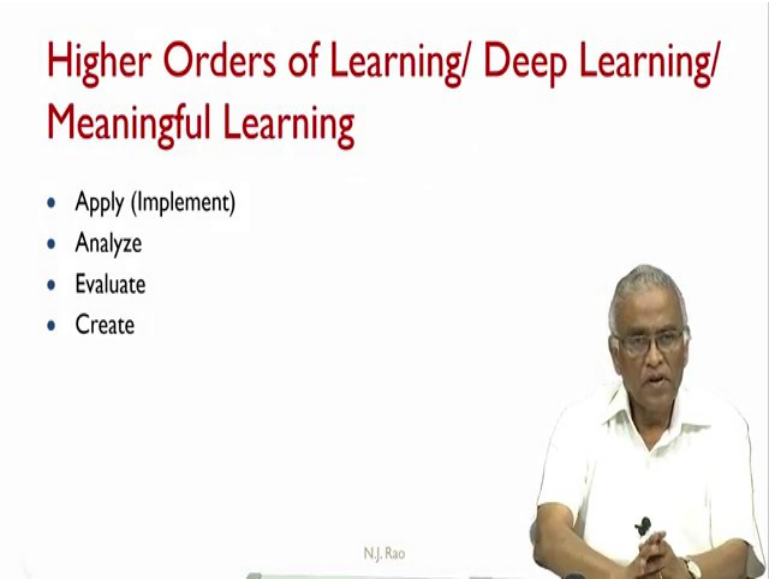

Now, we looked at all the six cognitive levels, but people also use what are called higher orders of learning, deep learning or meaningful learning. All of them are used in different contexts, but also approximately meaning the same thing. Apply has two sub-processes execute and implement. An implement is slightly higher level than execute because in implement you are required to make a decision of which particular procedure you need to apply and then apply the procedure. That is the reason why, apply at implement level, analyze, evaluate and create these you can say three and half cognitive levels are generally referred to as meaningful learning or higher orders of learning or deep learning.

Mind you, all courses all subjects that you are dealing with or at the level you are dealing with some subject they need not have all the six cognitive levels applicable, that is the very nature of the subject or scope of the subject. It is limited to only a certain number of cognitive levels - not all of them. It is not mandatory that every course needs to be dealt at all the six cognitive levels.

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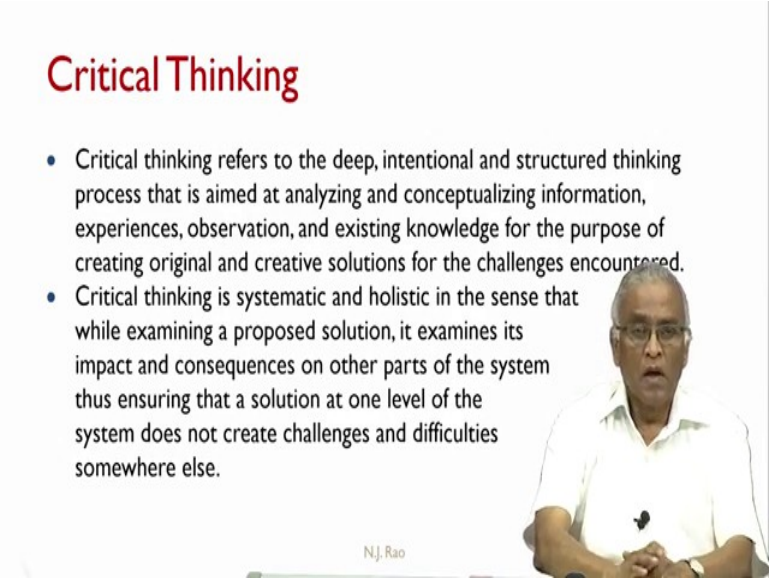

Now, let us look at these two words namely critical thinking and problem solving. Let me read what exactly formally it is stated: Critical thinking refers to the deep international and structured thinking process that is aimed at analyzing and conceptualizing information, experiences, observation and existing knowledge for the purpose of creating original and creative solutions for the challenges encountered. This looks like a fairly highbrow and very higher level definition of critical thinking.

A little more accessible definition is critical thinking is systematic and holistic in the sense that while examining a proposed solution, it examines its impact and consequences on other parts of the system thus ensuring that a solution at one level of the system does not create challenges and difficulties somewhere else.

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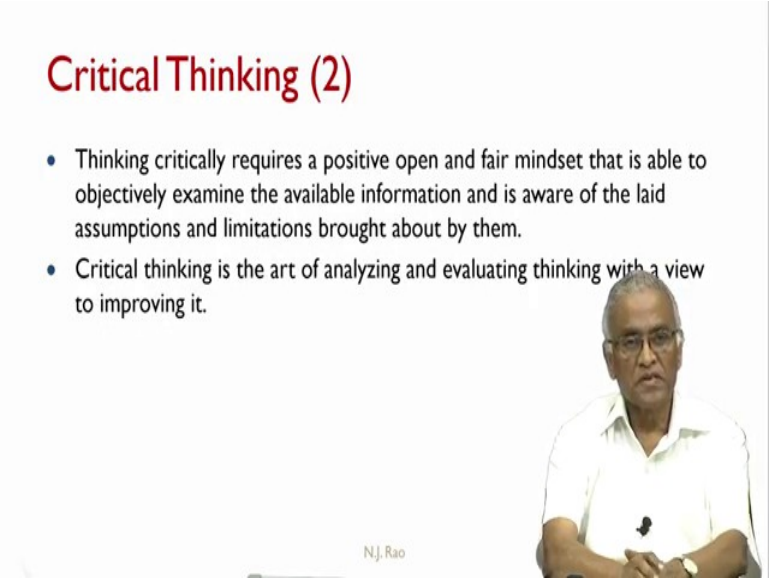

Let us look at some more features of critical thinking. Thinking critically requires a positive open and fair mindset that is able to objectively examine the available information and is aware of the laid assumptions and limitations brought about by them. Critical thinking is the art of analyzing and evaluating thinking with a view to improving it.

A non-example of critical thinking if you say is typically two people belonging to or two people having different party ideologies, when they discuss newspaper item, certainly they do not follow any of the features of critical thinking. That is a non-example of critical thinking, but when something is presented to you for example, as you can see in all these you are analyzing the information, you are also evaluating. So, what happens is the last statement shows that analyzing and evaluating and if you want because you are expected to come with a better solution you are also creating.

So, critical thinking will involve analyze, evaluate and create activities inside that. To that extent, the critical thinking in that sense is broadly subsumed under the Anderson-Bloom taxonomy. But if one wants to keep using the word critical thinking, the Anderson-Bloom taxonomy need not have any objection, Essentially it is trying to show a certain combination of sub processes of Bloom's taxonomy are involved, you are acknowledging that only.

And, incidentally there is an organization called criticalthinking.org setup by a large number of professors from number of universities in USA, where their goal is to understand the nature of critical thinking in various contexts and actually promote critical thinking. They have a large number of publications one can take a look at it.

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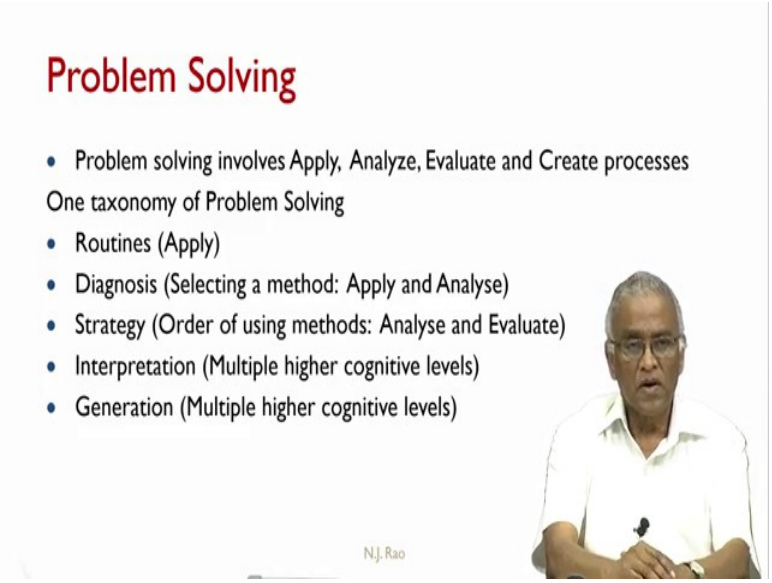

Now, come to problem solving; if you look at the literature, problem solving is merely used to the category of apply, but sometimes people also talk about problem solving in a much broader sense and where apply, analyze, evaluate and create processes are involved. So, to that extent problem solving is also subsumed under the six cognitive levels of Bloom. Someone proposed taxonomy of problem solving. If you say routine problem solving that something like routine like end of the chapter problems it is merely apply. And you may say you are selecting a particular problem solving method under some conditions. So, you can call it diagnosis and in that apply and analyze are involved.

And, then you are working out the strategy that means strategy would means you have several methods available to you for solving, but now you are experimenting with using different order of using these methods which will involve analyze and evaluate. And, you are interpreting a certain method of solving, then it also will involve multiple higher cognitive levels or you are generating a completely new way of solving, here also you have multiple higher cognitive levels. So, in whatever way you are looking at problem solving all the processes involved are subsumed under Anderson-Bloom taxonomy.

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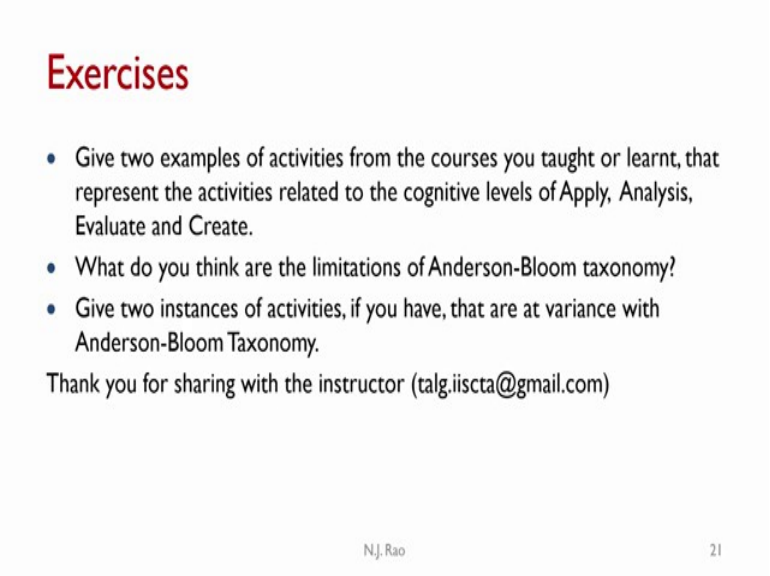

Now, we suggest to ensure that you really internalize all these concepts. Give two examples of activities from the courses you taught or learnt, that represent the activities related to the cognitive levels apply analysis, evaluate and create. And, as we said Anderson-Bloom taxonomy is not something absolute. What do you think are the limitations of Anderson-Bloom taxonomy? Or give two instances if you have that are at variance with the Anderson-Bloom taxonomy.

Thank you for sharing your answers with the instructor.

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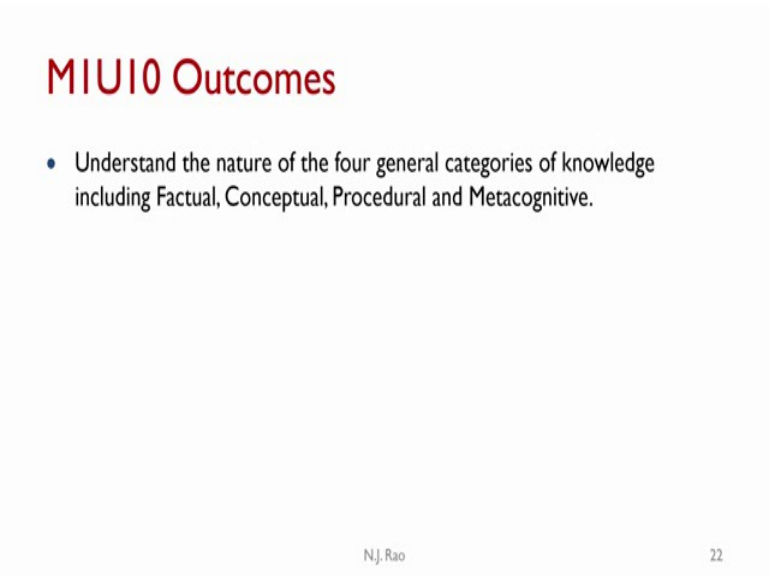

And, in the next unit 10, we look at the nature of four general categories of knowledge including factual, conceptual, procedural and metacognitive. These are the four categories of knowledge under the same Anderson-Bloom taxonomy that is the knowledge dimension will be explored in unit 10.

Thank you very much.