

## **Psychology of Learning**

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**Lecture – 15**

**Memory and Cognition (Contd.)**

Hello viewers, welcome back to this NPTEL course on the Psychology of Learning. So, in the last few classes we have been discussing working memory and its different processes, and what are the components of working memory etcetera. Now, to continue with this chapter only, we will discuss about cognitive load. I think we have just started the cognitive load, now we will continue further with what is cognitive load.

So, whenever we are processing the information the extra burden is cognitive load. This extra burden may be the task difficulty, may be the difficulty you are facing in understanding the whole content, content difficulty and in the process of solving the problems. All these are necessary works that has to be done. So, some kind of load, some kind of stress, some kind of workload on our memory system is cognitive load. So, how to deal with this cognitive load?

So, the cognitive load primarily emphasizes on two things. Schemas can also reduce the working memory load. So, our intention is how to reduce the cognitive load. But at the same time we can enhance the working memory processing ability, working memory capacity so that we can better retain it and that can be stored in the long term memory. So, actually cognitive load takes place during the working memory operations functions. So, here thing is that what are the heuristic, what are the strategies that we will adopt so that we can reduce our working memory load and we can process the information very effectively. So, here schema can also reduce the working memory load.

We have already discussed schema. Schema are ideas or concepts that we formulate. We frame ideas out of our experiences, exposures, environmental stimulus etcetera. So, schema can reduce load. When we form the different schemas about different stimulus and different or environmental information schema that means, we make it very comprehensive and get the theme or the get the sense of the whole stimulus whole range of experiences etcetera and then we compress it and consolidate into different schemas. So, that means, we are remembering only the few schemas behind each schema there may be n number of stimulus experiences environment etcetera, but when we compress it as a single schema and we store it in the working memory definitely it will be economical. It will take up less space and it will put less load on the working memory. So, schema construction. When we build up the positive or constructive schema that helps us in storing and organizing the information in not just in working memory, but it also works for the long term memory. Because once the load is reduced in working memory those information will be processed properly thoroughly and that can be compressed and stored effectively in the long term memory.

So, here the cognitive load theory is all about all these things. What are the types of loads, how to reduce it, how to process it and so, that it can be better retained. So, cognitive load theory actually assumes that limited working memory connected to unlimited long term memory. Yes

all of us we know the long term memory has immense capacity to hold the information, but the thing is that unless and until it is processed effectively, unless and until it we understood it properly, we comprehend it properly. So, then it cannot be stored for a long period of time. Long term memory has a capacity, but how long it is going to be retained or when how effectively it will it is going to be placed in the long term memory.

So, that in future we can retrieve it, reproduce it that depends on how effectively we have processed the information. And again where we are processing we are processing it is the working memory. So, that is where the work, but again working memory has also limited capacity. The visual sketch pad and the phonological loops and the episodic buffer whatever we have discussed it has also limited capacity in comparison to long term memory. So, that is why it is it becomes mandatory how to process the information most effectively.

So, that during the stage of working memory it can once it is processed effectively and understood and summarized effectively, then it will be retained for a long term purpose used in LTM ok. So, however, this cognitive load theory says that how much cognitive load takes place load happens or takes place during the working memory processing that depends on different factors. First thing is the for it is the causal factor there are different kinds of cause and effect causal factors are there and assessment factors of cognitive load. So, how to assess how to first thing is that when it is the cognitive load is been created ok. So, how to then how can we assess it like how we have to measure it how much cognitive load it is causing it is and what are the causal factors ok.

So, these two things are important in determining the cognitive load. So, what are the factors that causing cognitive load and how to assess the cognitive load. So, that we can map we can measure that this much of this much of volume or intensity is the of this cognitive load. So, that will affect the so, working memory capacity. So, causal factors can be the characteristics of the subjects ok.

For example, what are the causal factors like the cognitive abilities of the cognitive ability subject task and environment and the and mutual relations. So, for example, suppose we are we are learning a content. So, suppose it is the mathematical content. So, the subject mathematics it has an inherent complexity. So, that and that requires cognitive effort cognitive ability.

So, the subject is the nature of the subject itself has some intrinsic load intrinsic difficulty level complexity. So, that creates another because in order to understand the math some then to think of it is a probable solution and to work out all these things it requires cognitive effort cognitive ability. So, that itself creates a load then the task complexity yes one is the nature of the subject then is the task complexity. What is the difficulty level of that task? What is the difficulty level of the mathematical problem? But what is the difficulty level? So, task complexity some of the sums are very easy some problems are very easy, but whereas, the other task are very complex very difficult or very indirect. So, what is the inherent task complexity? Then the environment in which environment actually we are studying in which environment we are learning it whether it is a peaceful learning environment is a home environment it is a silent environment or you know there are very there are many disturbances distractors noise is coming up.

So, environment is also very important and then their mutual relation. So, how these three components for this task subject and environment how these three components they interact what is the relationship in between them. So, all these so, that is the combined effect and the mutual relations and the combined effect of all these three factors that also plays an important role that means, in creating that cognitive load. So, now, the these are the for example, this is the suppose this is the you know this is the figure this is a kind of figure here. Now, suppose this is the first thing is that we have to isolate these are the causal factors like task which are inherent there in the environment.

And again learners interaction with the task like task is the suppose subject and subject difficulty is there. So, that is available and then how the learner interaction with the task that means, tries to understand it analyze it then try to hypothesize it all kinds of things. So, interact task or learner interaction that when the learner has started about studying the reading that question reading the task taking of the task and analyzing and trying to solving the problem. So, task and learner interactions and the learner one is the task has the task environment task that task environment subject environment and the learners interaction and when the learner interacts with the task. So, these are the causal factors environment may be that noisy noises and all distractions that kind of that is not very conducive for understanding the task.

Subject difficulty is there subject nature of the subject task difficulty is there and how the how it has a direct interaction direct impact on the learner that is the one direct impact. And second is that when the task and learner interaction takes place all these combined. So, environment has an has a factor has an impact factor task and learner interaction has an impact factor and the learners learners ability learners personality learners health condition learner learning mental preparation his mental ability skills it has an impact. So, on all these all these pressures all these factors causing the cognitive load. So, individually as well as in combination.

So, it creates all these factors creates the cognitive load. Now, then how to how to assess assessment factors like for example, after that means, again that same performance learning outcome is going to be assessed ok. Here we have to find out what is the mental load, what is the total mental load and mental load again mental load like when the learner is engaged in solving the problem that is a it creates a kind of mental load mental load. So, that mental load can be of two types one is the control processing load another is automatic processing. So, automatic processing actually happens when it gets more mastery that means, it has been must it has been practiced again and again and the learner has acquired the mastery over the thing.

So, automatic processing some automatic involuntary processing takes place whereas, the control processing is the effortful that is the effortful intentional purpose processing of the information. So, that creates a kind of mental effort. So, when the learner starts to actively think about the analysis think about the possible solution think about the or trying to recollect the formulas or the algorithms everything all these things are making conscious effort to solve that problem solve that question. So, that is the control processing when try to put the all kinds of effort in the control processing in getting the solution that creates a kind of mental effort. So, and mental effort also directly affects the influence the performances.

So, here automatic processing has it can also directly affect the performance and the control processing. So, two things are automatic processing it makes it easier. So, automatic

processing does not create extra load and does not demand any kind of mental effort because it has already been acquired and mastered. So, all these things then when we assess we are going to assess then these are the factors we have to assess what is the degree of mental load, what is the degree of mental effort he is putting and what is the performance outcome. So, here assessment factors as we have already discussed it includes the mental load, mental effort and the performances the three measurable dimensions of cognitive load.

If you want to measure the cognitive load then we have to measure in these three components like what is the total mental load, what is the mental effort the learner is putting or it is required for the task and the performance, what is the level of performance. So, these three components combined together gives the idea about the score about the cognitive load. So, mental load is now portion of the cognitive load that is imposed exclusively by the task you know nature of the task, nature of the subject, task complexity and the environmental demands ok. And the mental effort actually refers to the cognitive capacity actual ability actually allocated to the task. Mental effort that suppose the task is very difficult and it requires a cognitive particular level of cognitive ability cognitive capacity.

So, that has been so, difficulty level primarily the difficulty level of the task which demands a particular level of cognitive ability. Then subjects performance finally, that is how he has performed, what is the reflection of this mental load and mental effort on the task on the task on the that is in terms of the subjects performance. So, all these things create the cognitive working memory load. So, working memory load actually is affected by this load is affected by the nature of the material that is the. So, it has been so, cognitive load has been defined in three terms ok.

First is the first is the intrinsic load intrinsic cognitive load is that the inherent nature of the subject inherent nature of the complexity of the task actually that is the intrinsic. Then what is the level of difficulty level of the particular problem particular mass problem or question that is the intrinsic cognitive load. And the manner in which the material is presented ok. So, they in which environment what is the requirements what are the environmental demands in the way it has been presented. Like for example, in the for example, in the examination hall how it is being presented either in question paper, in pen and paper and paper answer the answer keeps etcetera.

And you know what is the environmental factors like the noise it has all the other distractors have been controlled etcetera. So, the way it has been presented. So, in the regular classroom for suppose it is these study materials contents are being presented to the learners, but with the in a chaotic situation in the noisy situation. So, that environment has also some pressure on the and understanding the or solving the task. So, that also creates an another kind of cognitive load.

So, that is the extraneous factors that is called the extraneous factor. And the Germane load Germane load as actually is the actual ability to actual ability effort that the learner is going to put in order to solve that problem that is a Germane that is called the Germane cognitive load. So, what are these things let us know further. So, Germane load cognitive load is required for the construction and storage of schema. That means, Germane load is being created when we actually process well actually we comprehend while we actually process the learning materials in depth level we try to you know we try to adopt our own learning strategies heuristics.

So, that we can better understand it in processes. So, it is the learners effort to remember to understand to store that information for long term purpose that is the required that is required that is that means, you can say it is a very constructive cognitive load. That means, the learner is required to put that effort or take on this load to process the information in a very effective way and form the schema schema or schema task which are which will be stable which will be you know enduring and it will be stored effectively stored in the long term memory. So, that is the Germane load. So, Germane load is require how much it is required the load it is required the effort it is required for construction and storage of the schema.

That means, how effectively we can process the information and how effectively we can store it in the long term memory that is the Germane load. So, it is we can say it is a constructive load it is a helpful positive load. Intrinsic load is that the load what is imposed by the intrinsic characteristics of the time intrinsic load. That means, which is there inbuilt in the questions inbuilt in the process in the problems. So, that we are suppose we are supposed to answer this question or that problem or that experiment etcetera.

So, what is the inherent complexity of the task that poses some kind of load that is called the intrinsic load. So, usually in the conventional classroom instructions tend to impose extraneous cognitive load or not working memory whereas, the learning something requires shifting from the extraneous to general. For example, suppose in the classroom environment may be that unknowingly is every subject every task has an inherent intrinsic load, but to minimize that means, to come coming to the pin point intrinsic or a load that there are may be there may be other distracting factors extraneous loads. You know noise environmental factors over you know over that overloaded content may be background information something etcetera which can also create extraneous which is unnecessary cognitive load ok that is called the extraneous cognitive load. So, and in so, that is an in instructional it has the implication that in instructional design we should design the lessons in such a way that our intensity is that how to reduce the extraneous load unnecessary load which creates a kind of you know which occupies a extra extra space in our memory working memory or extra effort when learner needs to put extra effort or get distracted attention got distracted all these kinds of things.

So, how to reduce minimize this extraneous load and yes of course, intrinsic cognitive load intrinsic nature complexity of the task will be there because with the developing stage with the increasing classroom or level of learning the intrinsic load will be there. But our efforts should reduce this extraneous cognitive load, but at the same time also so, that when the extraneous load will be reduced then it can give more space and more energy more effort to work for the Germane load which is actually required for that. The better understanding the better mastery the better processing of the information then it can be retained for the long term long run and the LTM. So, that is why here if suppose we want to calculate the total cognitive load of the instructional design. So, intrinsic load that is the inherent nature of the task complexity of the task how much extraneous load we are creating that we need to reduce it.

So, unless and until we count it we count it we take notice of it will be there. So, how to isolate it this extraneous load. So, that that is an extraneous load how much extraneous load is there and the Germane load that is actual cognitive effort the learners are putting. Because here the Germane load is also related to the level of processing for in depth level of processing for in depth knowledge we need to put the more Germane load, but that is also effective for long term memory. So, though when so, for any instructional design any lesson plan we can count it yes this is the inherent complexity of the task we need to give them to activate the analytical skill higher order thinking skill it is required as per the task.

But how to reduce the unnecessary information repetition unnecessary distractors or lengthy questions the language the vocabulary all these are the extraneous loads. Then that is how to simplify the instruction how to give the you know give the put the questions in a very direct form or minimum distractors minimum that is with minimum use of language, but the clear meaning that means, no ambiguity is there etcetera. So, Germane load is that yes how much effort actually they need to put and with the depth of information processing then it can be written. So, that is the that is more about the cognitive load. So, working memory when the working memory has a limited capacity for processing the visual information, spatial information, auditory information and episodic buffer works from time to time to you know to integrate all these things.

So, that how effectively it can be solved can be resolved can be summarized can be made can be completed so, that it will be written. So, how so, till that point the information will be there in the working memory. So, but with the limited capacity of working memory how effectively we can process the information in a meaningful way. So, that it can be written in the long term memory that is our effort. So, but in this process cognitive loads are being created because of the subject, the task, the instructional design, the classroom activities all these things.

So, the basic purpose or implication of this thing is that how to reduce this unnecessary extraneous load and how to boost enhance this Germane cognitive load that. So, that the learner will slowly and steadily will be become more effortful, more analytical and it also enhances the thinking power thinking ability. So, that the whole learning outcome performance outcome will be effective and it will be retained. So, so, what are the effective ways of reducing the cognitive load these are some of the things like whenever we are we are learning where suppose we are learning subject like history how to remember, how to memorize, how to retain all this information narrated in the text book in different lessons. So, we must adopt some kind of heuristic method, some kind of strategy for our own remembering because again individual differences are there every student every learner is different all the learners they do not have the equal storage of memory or memory capacity or attention span etcetera.

So, how to use some effective strategies ways and means to reduce this cognitive load first is the one concept per page. Suppose we have gone through the whole page then try to identify there what are the key factors key concepts key concepts are there. So, we in that way we can summarize the whole information given in a single page with one or two schemas or two concepts two ideas etcetera. So, remove the non relevant items non relevant items. So, it is a which are unnecessary like for example, when we have when we have we put an overview when we do then overview to the information we try to summarize it scheme it oh this is the basic meaning this is the basic important things and other things are other things are non relevant.

So, choose and concise and writing cell then again how to write it very compressive very how to summarize it in a very comprehensive way and in how to prepare the abstracts and summarize it very effectively information access in the process of suppose it info it this some kind of materials are very you know very informative in terms of you know giving data information dates all kinds of events n number of things are there. So, how to group it how to chunk it maybe in terms of suppose many events many wars suppose for example, in history many wars that have been played by faced by different rulers etcetera how to summarize it. So, in we have to categorize either by the name of the rulers or by the age or by the you know dates or the factors we have to summarize it by or chunk it group it by giving some kind of some

kind of you know keyword that also help us in summarizing the summarizing the theme. So, that we can the thing is that our memory maximum memory capacity is limited, but how by strategically using this techniques we can retain the retain the materials in a very effective way like the whenever suppose we now here we are saying that we are just summarizing whole things into suppose 5 points within that 5 points whenever we can if you can remember this 5 points then we can recall all the background knowledge information that we actually do before the examination also consolidate the key learning then at the end of the end of the chapter then we have to summarize it write it in our own way. So, that these are the main events etcetera to summarizes consolidate our key learning then use the consistent structure consistent structure in the pattern the way we have to put it either that means, how to continuously you know that means, we have to give the some experiential things and how to reduce the some like how to give the maximum cognitive effort in understanding the information, information assimilation etcetera.

So, in this way we have to follow a particular consistent structure suppose we because in consistent structure also we develop a kind of learning style and preparation which helps us in remembering the things then linking back to the learning objectives then again whenever we are learning definitely we have to link it what are the instructional objective what are the aims and the goals of this learning what are the learning learning that is the learning objectives lesson plan, lesson plan objective etcetera. We have to make the relationship we have to link link back to the learning objectives or what we are supposed to learn what we are supposed to deliver. So, that it helps us in the key components key learning points summarizing it any simplification all these things. So, these kind of things in this way we can reduce the cognitive load consciously and we can enhance the retention capacity. So, anyway however, there are certain other things like how to protect our memory knowingly unknowingly like for example, our like the like the computer it has the it has the maximum capacity.

So, unless that means, often it gets overdue that means, it is packed it is over that means, filled up. So, how to similarly our memory may system is also it has also limited capacity, but suppose it gets exhausted it gets overloaded. So, how to how to learn the new how to store the new learning principle new learning things then that is why from time to time we need to unlearn certain things we need to unlearn certain things. Also other factors like avoiding the stress stress you know stress factors stress causes the you know it has the detrimental effect on the memory including the including the brain the area of the hippocampus. So, how to avoid the stress avoid all kinds of you know neurotoxins alcohol drugs etcetera it has also a bad in negative impact on the brain.

So, and again we need also the enough of exercise enough exercise particularly related to breathing exercises special breathing exercise because when we were engaged in deep breathing or inhale and exhale with a regular pattern then when the thing is that the basic purpose is that when the oxygen maximum oxygen is being inhaled and it goes to the brain then the brains functioning power the neuro function neuro chemical functions becomes effective. So, here to this is called the oxygenation of the brain. So, primarily by taking more oxygen by deep breathing by meditation by yoga all these kinds how to strengthen the how to empower our brain with the with the you know with the you know with even nutritious food also nutrition food nutritious food with enough of sleep with enough of you know vitamins with enough of oxygen. So, these are how to take care of our brain through different kinds of exercises. Similarly stimulate the brain means again brain is a machine then how to activate keep it in a running condition in a very effective running condition that is how to how to strengthen how to in how to enhance the brain power.

So, that is called you know how to stimulate our brain like for example, proper exercises proper utilizations of its functions and activities. If unnecessarily we overload our brain with you know all kinds of rubbish materials all kinds of rubbish things about in the social networking so and so etcetera. That means, it because even though we play it for the casual or the play it for the you know for entertainment etcetera, but the information is getting the information is going into the brain as an input material and then again it is so, unnecessarily it occupies the space. So, why to why to use why to over burden the brain. So, stimulate the brain, but in a constructive way that like for example, doing some puzzles doing some mass solutions doing some you know geographical architecture something some constructive things.

So, that it can strengthen the brains mechanism or else it is by or not at all using the brain also it is also it becomes dysfunctional slowly because brain is a machine. So, the right kind of function actually it energizes it stimulates our activities our mental power and skills abilities, but unnecessary information unnecessary content all these things also over burden because it occupies the space and so, that is redundant which is actually. So, that is why from like the you know from time to time we you know we refresh refresh our computer similarly we have to unlearn certain things to you know to learn new things to learn new things. So, we have to we have to get rid of this redundant things you know old things etcetera. So, that is the researchers have found that the more actively we are we can stimulate our brain through new kind of exercise a new kind of task primarily processing task in instead of just data input we can also we should also engage ourselves in processing the task that can reduce our reduce our dementia or memory loss or you know memory loss or you can say memory loss especially when we say that oh in the aging process in the aging process actually memory loss takes place that is not the issue, but how actively even at the old days also how actively you are busy with different kinds of activities like the people who are habituated to reading were habituated to all kinds of puzzles activities on those who are you know who are who are actually very active in the workplace with different kinds of stimulating jobs in tasks etcetera and they love it they are very interesting thing.

So, in in case of them actually these people they dementia does not take place. So, either once old saying is that use use it or lose it yes interference also takes place forgetting also takes place with the disuse of when we for a long time we are not using something automatically we will forget it or or or else when we overburden our brain with unnecessary information that is also another reason for getting takes place. So, unnecessary how to reduce the overburden unnecessary overburden of the information how to reduce reduce it then again how to unlearn it how to then how to use the brain skillfully how to stimulate the brain and both biological also taking the good kind of food mental health exercises all kinds of things. So, this is the like how to protect our memory means how to protect our brain activity. So, these are some of the things tips again another thing is I will maintain the sense of self-efficacy always the more active we are though more engaged we are.

So, automatically gives a gives us a kind of you know feeling of self-efficacy. Now, even at the age of 75 or 80 we can think of no I am very active I am very I am I am very very confident I can do anything because. So, so that kind of you know that kind of active in a stimulating brain also gives us a kind of self-confidence that is called the self-efficacy. So, age is just that is why we say that age is just a number it is not a it is not a matter it is not a causal factor. So, that enhances our self-confidence self-efficacy and also you know it keeps it keeps us going even in at the even after retirement even after completing themselves. That is because all these active kind of people have some or other projects and tasks.

So, how do we improve? There are some mnemonic strategies learning strategies that we can do. Suppose when we are learning something pleasure or learning for preparation, or learning for presentation, or learning for exam. So what is the purpose matters a lot. What is the expected performance? When we are learning for pleasure then we need not have to remember everything, but we just enjoy the learning. But when we are supposed to produce something or supposed to design something, supposed to recreate something then we have to actively prepare it. So, suppose we are going to present something within 15 minutes then we have to write down the bullet points.

So, the reasons structures all these things. So, we need to write it down then attach meaning to it. Suppose we are remembering or trying to recollect it or analyzing something or introducing some new information, we have to give some meaning some background some logic some rationale behind it. Repeating of course, helps. Your self-repetition helps in achieving the mastery over the things. Then grouping it. chunking it and testing yourself. We can also do some kind of self check exercises where we can self assess ourselves. We can get the feedback from peers. We can evaluate ourselves through peer feedback or self check exercises or some online tests are also there. So, that is testing ourselves. That means, mapping our own competency to what extent we have been successful in acquiring, in learning certain things and take a mental picture at the end of the thing. Even while studying different subjects when we frame a concept, we make a concept mapping chart. Similarly, when we are studying, we are jotting down the key points in a page. Through one page sketch or figure or image we try to consolidate the information. We compress the whole thing. So, that is taking the mental picture. That means concept mapping or mental mapping of the whole thing in a format of one image one picture. It helps us immensely because not only we have learned the things by heart in the main components, but we have jotted it down a very comprehensive way and once we remember that image itself in the mind map in the concept map in our mind then while image the remembering the same one page concept map or image itself can lead to recalling all the background information.

Getting enough rest is also important. Sleep is also very much required. Nutrition is also required. You can use certain memorizing techniques like rehearsals of information implying mnemonics, certain coding system. Yesterday we were talking about different codings. Giving your own cues to remember certain new things. You add your own term key terms and new cues. Suppose you are very fond of music then you can give some musical singers or music directors or maybe some instruments name as the keyword.

So, it depends on you. It depends on the individual choices. So, in this way we can we can use different memorizing techniques to retain the maximum information and this is the end of this chapter. Now in the next week we will pick up another topic related to learning and psychology, Now, thank you very much. I hope you have understood the whole thing, in a very effective way. Thank you.