Psychology of Learning

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Lecture – 14

Memory and Cognition (Contd.)

Hello viewers, welcome back to this NPTEL course on the Psychology of Learning. So, in the last class we were discussing about working memory and how this working memory model functions and what are the subsystems components: visual sketchpad, phonological loop and how these two along with episodic buffer integrates the information for further processing and saving it in the long term memory. So, now to continue with that memory system, we will discuss the different types of memory. As you can see once the memory, the information are stored in the long term memory just like the computer. The information is being stored under different files different files with different symbols and different types of information.

So, we can say this filing process is being made in the long term memory to save large number of information because at the moment we are receiving n number of information all types of information in different context across the time, across the domain, across the context. So, it is also classified, categorized and stored in the long term memory for a meaningful retrieval also. So, you can see there are different types of knowledge. So, that is the way the information is being converted into a particular way like a metadata or something like that storage process to name it and to store it in different categories or classified way.

So, declarative knowledge, procedural knowledge, episodic knowledge are in the long term memory. So, let us know what do they mean. So, declarative knowledge is numbers etcetera all the kinds of data, information in terms of numbers, in terms of name, in terms of some raw data that kind of thing declarative in terms of dates, in terms of phone number, in terms of some verbal components. So, this is the declarative that in other words we say that the general information the general knowledge that is in terms of data, data set information. So, that is the declarative knowledge.

It is the extensive capacity of knowledge and information that we can hold on. So, that is the 'know what' know what of the information. So, then, we have procedural knowledge. These are procedural process like for instance during childhood, in schooling or young schooling stage to adulthood, we go on different stages, we go on studying the different kinds of subjects starting from math to science to so and so etcetera. So, how do we learn these things and at the end of the day how do we process, how do we conceptualize them? So, that is the 'know-hows' that means, whole process of what have we learned, the procedure, the process of learning, process of doing, the process of solving different mathematical problems.

The process of doing solving the conducting some mechanical experiments or lab experiments itself that forms the know-how. How have we comprehended the whole thing, how have we understood something. After solving whole different kinds of problems, we learn like how to solve the problems, how to solve this task, how to learn this task. All these are know hows. So,

that is called the procedural knowledge. Procedural knowledge that the processes that we learn in terms of mathematical formulas or mnemonic strategies or events how to remember the historical events, geographical knowledge every subject has some inbuilt structure inbuilt structure to learn it to understand it to remember it. So, this is the know how of learning the subject.

So, this know hows is the processes that is the procedural knowledge like we summarize after learning this we summarize it combine the whole thing in an interpret in different languages vocabulary, comprehend the meaning, interpret it, pronounce it, categorize it and so that then we remember it. Then that means, at the end of the day like we know that how to solve it, how to approach it, how to resolve the issue. So, that is all the know hows that is called the procedural knowledge, how to conduct, how to deal with what type of problem, what type of subject content, how to deal with that is the procedural knowledge that we graph we learn over the years of our schooling and education ok.

So, next is that episodic knowledge. Episodic knowledge as the name implies it is related to particular episode, particular event ok. So, I remember when I graduated so, often we also remember and we recollect some of their old memories you know some happy moments, some experiences that we exactly remember the way it has happened actually. Like suppose for example, the our experience the moment like when we received our you know graduation degree or when I we received some PhD degree and the convocation. So, we in detail we have remembered what has happened to happen in that particular event that is the episodic knowledge. The bit by bit everything we could remember that is the episodic knowledge that and why did we why do we remember it? Because, maybe because of some our you know maybe because of its importance is relevance, it is value in our life. So, we remember the whole experiences of their bit by bit information of that event that is called the episodic knowledge. Particular event in detail we have remembered everything.

So, here we can say for example, here declarative knowledge is you know all the general information data etcetera that we have to deal with in day to day life like you starting from the mobile number, phone number to dates to event to numbers all kinds of the factual data actually the factual data that we remember in our data because we have to deal with it. Procedural knowledge is that we are very often we need to do or we need to practice, we need to resolve, we need to solve some of the challenges. So, it is there in our LTM. So, we can retrieve it for this solving this kind of technical problem, this kind of mathematical problem, this kind of you know geographical problem whatever we have.

We have the you know we have the heuristic in our mind because we have already done it, gone through it, experienced it and we have come up with the idea. So, we deal with quickly deal with the procedural knowledge to how to solve the problem or how to deal with the task. And episodic is primarily it is related to our life events from our experiences, from our experience, a learning life events. So, these are the categories primarily three categories there are also other kinds of sub categories also. So, these are the primary categories in which the information are being stored in the long term memory.

So, this is the flow is you can say this is the flow of information how it goes like for example, we have episodic memory because life events that we experience we have that episodic memory. We have the declarative mean memory that is in explicit form in terms of factual knowledge, data etcetera. We have the when from these two when we relate to some meaning then it becomes a semantic memory. So, for example, suppose the concept like

primarily the philosophical abstract concept like suppose we talk about you know gender equality, we talk about democracy, we talk about you know we talk about you know you can say feminism. Suppose this so, it how does we remember it because in terms of meaning that we have grasped ourselves.

So, that is the semantic memory that is the meaning related to particular content. Then so, then we have the episodic memory, we have the again experimental episodic memory. Experimental suppose we are engaged in particular kind of experiment any lab experiment etcetera. So, what has happened in a particular context that is experimental episodic memory. Similarly autobiographical episodic memory that is about our life events autobiographical when we narrate our autobiographical our own life experiences then how we have remembered is what are the minute details in which minute details and all kinds of the feelings, emotions, all kinds of all kinds of minute details how that is autobiographical episodic memory that exactly what has happened in our life.

And the flash memory is you know just the key points of the vital points etcetera. So, in this way when it enters into the long term memory, long term memory it in these process different types of memory it goes into the long term memory. Then thereafter and procedural memory primarily it relates to our you know it is a kind of implicit memory or you can say in the computer we can say the softwares softwares that means, it is stored there for solving different kinds of tasks. So, that is the procedural memory implicit memory. So, episodic procedural and semantic memory.

So, LTM long term memory can be split up declarative memory that is the explicit memories that can be related to or inspected or recalled consciously explicit memory, procedural memory which are implicit in nature that we are typically unable to consciously recall, but we have to we have to practice it we have to verify we have to that is with that help we have to solve the problem. So, the know how and declarative memory can be further sub categorized into episodic and semantic episodic memory what has happened in a particular event particular time slot particular context and semantic memory that when we interpret it in some in terms of some meaningful experience etcetera. So, episodic memory refers to any event that has to be reported in the person from the person's life during the particular period or span of time. And primarily episodic autobiographical episodic means memory specific to one's life events at different stages. Experimental episodic memory you know it is a learning of the fact in a semantic memory in the semantic where the learning of a fact in the semantic memory actually.

Episodic memory that semantic memory is also a type of declarative because when we get the meaning out of it. So, it also becomes declarative in nature because we explicitly elaborate it recall it what exactly it is. So, that also becomes a semantic also procedural memories by describe primarily the implicit knowledge the task that are usually not required to consciously recall them exactly, but also it helps us in performing the task that means, the know hows it is the know hows of the task. So, now this is the working memory the model now the another kind of theory in the memory was there level of processing theory. One is that one working model working memory theory is over now the level of processing theory.

Here again how much it is a question of how do we remember most or how the things are remembered better remembered in long term memory and how long and what are the mechanisms for that and how how can we retrieve it efficiently competently all the things. So,

it depends on actually depends on how the information are being processed. So, one such mechanism is working memory how it processes the information that we got to know it.

And next another theory says that Craik and Lockhart that level of processing theory that means, how we have processed the information at what level. So, what level we have process the information and that depends on that depends it depends that how much information is being stored in our long term.

Whether we have superficially processed it or we have meaningfully processed it by giving our meaning interpretation our that means, further coding further enhancing the further explanation and narration whether that stage or maybe that in between as per the requirement maybe that in between intermediary pathway as per the requirement like the strategic strategic processing like the as it is desired as it is required. Like for example, I am giving you three examples shallow processing is just the superficial processing like for example, when we prepare just before the exam and somehow we try to complete it memorize it practice somehow we have to we manage it to you know to deliver to produce the maximum to deliver the maximum in the exam ok. Without attaching very many more value or meaningful experience etcetera because we do not have time it is very within short time we just. So, that is the kind of shallow processing by adopting applying this rote memorization or some pictorial things etcetera. So, how to that is that is the kind of shallow processing that somehow to deliver it.

So, as soon as the exam is over as soon as the term is over then sooner within the two weeks two or three weeks we will forget it ok. So, that is the kind of shallow processing example this is the example I am giving. And deep processing is that in depth processing because we need to when mostly actually mostly we need to we are learning it we need to analyze it we need to go into the depth because we love to do it or maybe that it is a part of our a part of our profession part of our learning experience requirement etcetera. For example, deep processing you can say with the semantic encoding with giving more value with critical evaluation with reflective thinking maybe it is a part of our you know core interest in a particular domain like the scientist they used to do experiments or the you know researchers also they want to go into the depth or even the geologist they want to go into the root cause or the deepest level. So, these are can say because we not only explore the details, but also we try to interpret it meaningfully ok.

So, here we can say the depth of processing that is the depth of processing shallow processing is the structural encoding in the first emphasizes the physical structure of the stimulus like the moment the is the is the word written in the capital S. So, for example, there is just before the exam how can we maximally remember it how can we maximally deliver it and what are the clues what are the key words what are the heuristic that we are going to use it. So, that we can remember maximally and deliver it that is the shallow processing, but we are not gone into the depth of its meaning. So, intermediate processing is that phonemic coding emphasizing what a what the word sound like sounds like that. So, here we can say does the word rhyme we do wait like for example, here intermediate as it sounds as it requires as it is as it is demanded as the task demands or as the exam demands something like that.

So, here and the deep processing as you can see the deep processing here deep processing is the semantic coding emphasizing the meaning of the verbal input like for example, in the depth in depth when you go into the underlying meaning and interpreting the meaning when we try to do it try to conceptualize comprehend it as the meaningful experience meaningful experiment meaningful information. So, semantic encoding when we encode the

information data at the semantic level. So, semantic you know semantic memory it will be stored. So, that is it requires a deep processing in depth. So, in the last few classes we discussed about the mastery learning.

So, mastery learning actually focuses on this kind deep processing like it is not just superficial learning knowing the facts knowing the meaning and just understanding the thing in that the superficial level, but going into the depth adding more value meaning when whatever it is there inherent meaning, but moreover in order to remember it further we add our own heuristic meaning to that own coding. So, second level third level coding we narrate it in different ways. So, that is the deep processing. So, the level of processing theory says that it depends how much information is being stored in the long term memory depends on at what level these are being processed. So, here we can see just yes level of processing the way information is encoded affect how well it is remembered the deeper level the information the deeper the level of information is in information processing the easier the information is to recall.

So, structural level that look like somehow similar it we recognize oh maybe this is similar as a style of processing phonetic is on the basis of sounds on the basis of sound system then we it is stored in the short term memory then it goes to the long term memory that is the phonetic it will be primarily depends on the phonetic processing auditory processing. And semantic level the processing deep level processing is primarily relates to semantic memory because it relates to the meaning then. So, here we can say whether we have processed the information at the structural level look like shallow level maybe that numbers or size, shape, color something like that at the shallow level visual on the basis of only visual visual information that is shallow level and phonetic is auditory how the auditory information is being processed then accordingly it will go to the long term memory and meaningful that semantic if it is related to semantics and then and so, it is related to further processing deep processing. So, here in this way it goes to LTM. So, shallow processing is only inform involves the maintenance of the rehearsal ok.

For example, structural processing like appearance which is a like whenever we want to code some physical qualities like suppose typing later somehow suppose the type phase of the word whether it is written in italic white this and superficial some of the superficial visual information or the clues etcetera we want to remember it. Phonetic processing is that when it is when we encode the sound phonetic kind of things and phonemic and the visual process words involve shallow processing and less accurate require somehow because we have not further worked on it we have not further practice on it. So, these are with the shallow processing it involves both the structure visual structural as well as the phonemic processing, but at the very superficial level.

Deep processing actually involves elaboration rehearsal like whatever you have studied we analyzed it we went we went through again and again we try to interpret the meaning on our own way we then. So, meaningful analysis actually which involves meaningful analysis either in terms of images thinking associations of the information and leads to a better recall suppose by for example, that is why suppose when we are studying the some topics while going through the topics we do one thing that when going through the topics what happens suffer along with the words while along with the content we are going through then we draw our own map we draw our own map.

So, we draw our own map in the sense that we how to that means, we how to that we develop a kind of concept map we develop a kind of concept map like how to remember the

whole chapter in a very easy very easy way very memorable way. So, we draw our own chart we draw our concept map we draw maybe we try to remember it by color coding the different words. So, so that it makes some association makes some association which we can remember it further. So, in this way we apply our mnemonic strategy heuristics to remember the whole thing. So, moreover what happens sometimes some words we need to then we write more explanation more elaboration on that topic on that word.

So, that is that further elaboration for the narration. So, semantic processing is that is meaningful which happens when we encode the meaning of a word and relate it to similar word with the similar meaning. Like for example, semantic processing is that suppose we are coming across a new vocabulary some new word we try to get the meaning out of it by getting it synonyms by again further analyzing its interpretation different context by analyzing the deeper meaning. So, semantic process is thing is that we try to understand its inherent meaning how to remember it and how to find out its similar words synonyms. However, the synonyms what are the again the differences applications of the synonyms in different context.

So, semantic processing then at the meaning level we are processing it. So, semantically processed words involve elaboration rehearsal and deep processing which results in more accurate recall. So, for example, as because not only we are spending time we are spending more you know processing of the information where you know we are actively engaged with higher level of thinking where because suppose when we are elaborating we are analyzing we are reflecting etcetera all our higher cognitive processes are engaged. So, definitely it is bound to be remembered because we are engaged actively engaged not just passively we are mugging up, but we are actively engaged we are thinking of we are reflecting we are critically evaluating. So, automatically we will be it will be remember.

So, elaboration rehearsal and deep processing takes place when we semantically analyze certain words and research studies actually have clarified that deeper coding produces better retention because it is more elaborate. So, for example, you know in computer language we say that coding information how to code the information that is coding they are coding is a skill coding etcetera. Similarly, in our human life in actual life also whenever go through the some studies we can also code it in our own language as per our convenience. Suppose we like we like paintings or we like some technology we like some by giving some like we are familiar we are we are very suppose we are very techno savvy by giving the technical words computer words IT words we can code the thing further for further processing. So, this deeper coding actually it produces better retention to capture to hold and to recall the data information in from the long term.

So, elaborative encoding elaborative encoding enriches the memory representations elaborating that means, we further elaborate it for the narrate it for the give that additional cue or the code codes and so, it actually it we try to develop it not just in terms of coding with vocabulary etcetera we also try to develop mental picture and image representation memory representation. So, that is definitely is more meaningful and it is more it is going to be better remembered because it is that means, it is meaning is and linking to a pre existing network of semantic association. Elaboration encoding elaborative encoding giving the heuristics giving the memory codes narration it further enhances the meaning and the semantic the information and the data that has to be that will be store for a longer period of time. So, latest research indicate that processing is more complex and varied than in the level of processing. So, this is the basic idea about the different types of processing and how processing takes place all these things sensory memory, short term memory, long term memory everything has been

analyzed even here in the table you can go through it.

And now then again here comes to your human memory a human memory and computer comparison because you know the information processing theories those who have adopted computer as a metaphor how they want they assimilate like the computers think these are the things you can sensory register is the input device short term memory is you know CPU and the long term memory is your hard drive in this register. So, human information processing model it is given how it functions then another theory is that the brain based learning the neural network model. So, neural network model is primarily cognitive neuroscience aspect bio cognitive neuroscience aspect. So, I am just giving an instance an example, but actually our basic intention is not to go into the depth because I am not the expert in neuroscience. So, memories as long as they influence our thoughts and feelings that is the main thing neural network how the nerve how the neural network actually work functions in our brain.

So, that means, the synapses the neural network how efficiently. So, cognitive science people they used to take it the fundamental components of this neural network model is that our ability to acquire any knowledge and skill and how the memory capacity actually of according to these theory depends on the complexity of the synapses the sparseness of the representation the special and temporal memory connection between the memory memories. That means, here how our neural system nervous system brain neural system networks actually functions and our capacity like the you know the yes of course, the brain neuro chemicals the speed the you know the you can say the impulses that is impulses like the you can say the signals the neuro electrical signals all these things actually decides how the brain functions and how the memory can be interpreted. So, representation the spatial temporal correlation all these mathematical and you know scientific things are there. I have just given it as an example of as because we are covering, but not in not very much going into the depth.

So, complexities important synapses can only be modified and with the limited precision and the biological synapses sparseness can greatly be increase the how that means, the nerve impulse the signals you know the signals the electric signals electric signal all these things impulses all these how these are being created how it can create the different neural networks. And so, I depend on the basis of that the you can say the type of neurons they group together they integrate and it defines our memory how the memory is being structured all it is all related to cognitive neuroscience. Here like it is a picture I have just given it how the neural network of the brain functions these are the impulses and that is the nerve impulses that has been elicited and how to count it calculate it is only the task of the cognitive neuro scientist I have just given an example of only I am not going into the depth of and the research finding one of the example I have given it here is here the model for the memory travel based on the hospital neural network it has just I have given it as an example. So, now, I am not going into the depth just as because it is a theory I have just given the basic preliminary information. So, now, we will come to the next part that is cognitive   load.

So, now, we have already discussed about the memory system how do we remember how do we process information how much can we remember how much can we recall retrieve all these things. So, here it cognitive load is that whenever we are receiving the information and processing the information and trying to remember it for long term purpose automatically we need to process the information there are different types of information are coming. So, here it creates a kind of load kind of load work like we say that workload. So, cognitive load that are being created when we are processing dealing with different types of information and we

need to process it at different levels and we need to retrieve it store it and use it for multipurpose use. So, here we can say here the cognitive architecture is the structure what is the structure? What is the structure cognitive architecture for narrating the cognitive load is the memory and the schema.

Schemas are nothing, but the our concept basic concept ideas that we have formulated over the years and memory is our processing capacity our working memory capacity our processing our even sensory organs our sensory registers all the whole memory system that we are having. This is the cognitive architecture that is the we can say the basic structure of dealing with this cognitive load. So, schema theory says that knowledge is stored in LTM in schemata like in terms of like here we can say it is more of a you know semantic memory semantic memory like when we go through the whole thing and we interpret it we summarize it into particular idea and we try to save it as in terms of a schemata or our own concepts or ideas etcetera that is the schemata theories thing. So, schemata actually categories the information elements according to how they will be used like you know that we talk about the different types of knowledge declarative knowledge process then procedural knowledge semantic knowledge autobiographical knowledge these things. So, schemata is actually it is our idea our interpretation of the data how we want to process it how we want to remember it how we want to store it.

So, a schema can hold on the huge amount of information yet it is processed as a single unit in the working memory. So, schema the moment we receive different kind of information, but at the end we need to summarize it make it more comprehensive we need to process it further to fit it into one single unit in the working memory ok. The whole situation has to be compressed we can say compressed into one single unit. So, the schema can hold lot of information at the moment, but process it as a single unit. Because, integrating all the information available in the periphery and solidifying it or consolidating it.

So, schemata can integrate information elements and production rules and become automated thus requires the less storage and less control processing. So, here the schemata when it tries is trying to consolidate the whole thing into a single unit then it integrates various information and also it also that means, it perfectly uses this declarative knowledge, this procedural knowledge, the semantic knowledge everything and the production rules etcetera. So, that it becomes not only single unit information this consolidated information sometimes at all it can also be become automated, automated requiring less storage and less controlled processes. Like in our day to day life suppose we have been doing something as a for a long time long for a long period. So, automatically it gets we get not only habituated to the system becomes automated the system it becomes automated.

So, once anything any task any ability any skill it when it gets automated means it has already cross the master level it has already cross. So, it becomes involuntary effortless it becomes effortless. So, once it becomes effortless means automatically it becomes automated. So, once it is automated means definitely it will require less storage space less processing because it has already cross that practice level cross that rehearsal cross that rehearsal level. So, automatically that means, it becomes now it has become involuntary ok.

So, when the data, the information, the schema becomes automated in the long term memory, it requires small space less storage and less control. We can quickly can recollect it. So, skilled performances consists of building the increasing number of increasingly complex schemas by combining the elements in an inductive sequential member. Skilled performance like suppose

for example, in order to perform certain thing, achieve certain thing. we need different schemas to be arranged in a hierarchical order. There are different kind of skills. There may be technical skill set or mechanical skill set or the IT skill set. So, this skill set requires n number of number of schemata not just only 1 or 2 schema, but increasingly complex schema from A to Z. So, we build skills by increasingly complex schema by combining different elements in an inductive way. sequential way. But it should be flexible enough, so that we can integrate it and flexibly   use   and   analyze   it.

 So, that results in skilled performance. When you call someone with IT skills, it means they have the different schemas, they can manipulate, they can explain, they can inter exchange inter use it. So, ultimately, they can experiment with different schemas and they have mastered it. So, they can flexibly use those schemas, combine those elements and can perform it. So, that is the that becomes the ends in the skilled performance. So, now, this is we have just begin we have just begun discussing cognitive load and in the next class we will elaborate it and complete it. We will discuss what does it mean what are the different types of cognitive load how to deal with it etcetera. Thank you very much.