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Innovative Lesson –Plan to Enhance Teaching –Learning Process in a Science Class-Room

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Abstract

Science teachers worldwide face tough challenge to present the content in a simple understandable way so that the learners connect the content presented to them with their past knowledge already stored in the long-term memory semantically. The teachers strive to construct scientific knowledge similar to the way a mother teaches the infant showing the pictures of living and non-living objects around the infant before developing the native language introducing the alphabets as well as the sounds related to them. At every stage of development, the infant connects new knowledge perceived with the knowledge already present. This is the natural way one recognises the information semantically by mental representations otherwise known as cognitive structures which quickly transforms from one to another depending on the environmental stimuli an individual encounter. This ability is innate in every individual. To develop this innate ability skill is needed. Therefore, a skillful way scientific knowledge imparted to learners in a class room could be achieved by practicing metaphorical thinking ability to construct scientific knowledge semantically. The paper discusses how metaphorical thinking statements enriched in a lesson plan enhances teaching-learning process in a science class.

Keywords: *Cognitive Structure; Metaphorical Thinking; Mental Representations; Intellectual Framework and Teaching/Learning Process*

Introduction

Cognitive structures develop in everyone from infancy to old age having neurological capacity to communicate. Hence the development of Cognitive structure could ease information processing ability among learners by (1) making connections, (2) finding patterns, (3) identifying rules, and (4) abstracting principles through the practice of Metaphorical thinking on content, activities and assessment. In short, this research paper highlights connection between Metaphorical thinking and Cognitive Structure through the following model.

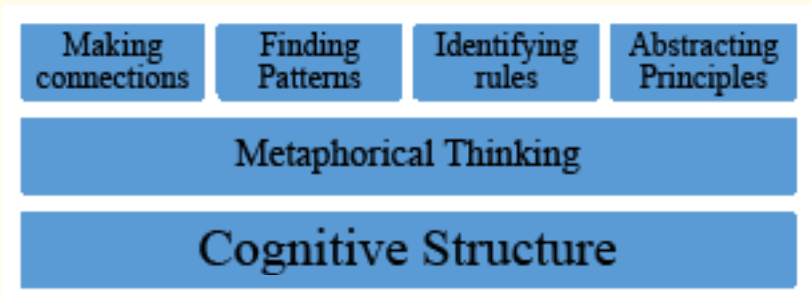


Figure 1: *Shows the link between Metaphorical thinking and Cognitive Structure.*

Making connections of present with existing knowledge

David Ausubel (1963) mentioned in his cognitive learning theory that meaningful learning could occur if the learner involved in active learning not only responds to the environment but also make sense of the new knowledge integrating with the knowledge already known to him/her. He strongly believed in the formation of cognitive structure as the knowledge one acquires by associating with the facts, concepts and principles attributing to the knowledge. According to him human beings represent the cognitive structure of the content we already know organized with larger, inclusive and abstract ideas of the content at the top level and more specific content at the bottom level. For example, if a learner is exposed to the concept of animals, his/her cognitive structure is organized in such a manner that the concept of animals occupy higher level whereas the concept of household pets occupy a lower level, that he/she understands the concept of animals by connecting it with household pets. Hence, meaningful learning is possible if there is a series of connection between the new information and the existing information within the cognitive structure. In recent years Siler Sunito (2013) predicted encouraging students to think metaphorically enabled them to develop cognitive structures by associating, experimenting, networking etc. fostering the ability to create, innovate and analyse the given content. Jean Piaget (1971) mentioned in his schema theory that the assimilation of knowledge occurs by linking the present knowledge with the prior knowledge by changing the cognitive structures that already exist adding new information. In order to promote this type of procedural knowledge, the information is presented by the teacher in small pockets at a time and guiding the students to engage in a series of cognitive development activities such as organizing, comparing and contrasting, summarizing, reviewing, Rosenshine (2002). Comparing and contrasting the given information that is promoting metaphorical thinking resulted in the development of higher level cognitive structures, Marzano and Pickering (2005). For example, if a teacher is explaining the biographies of Fedireck Doughlass and Hellen Keller should promote metaphorical thinking by asking the students to compare and contrast the biographies to find out commonality in both which would result in deeper understanding by developing higher level cognitive structures.

Finding patterns relevant to content

According to Cognitive Psychologists an individual's capacity to understand the given content takes place by transforming the factual or the declarative knowledge to applicable knowledge through a series of mental patterns by adopting learning strategies like what to know, how to know etc. In order to achieve this mental state, the learners gather, store, retrieve and use the information. Famous Psychologists like Skinner and Erik Erikson proposed in their theories of human development that every child is capable of constructing his/her own knowledge to understand the world around them. Therefore, it is the responsibility of the teacher to channelize the ideas of the learner to develop a concrete experience of the knowledge placed before them encouraging them to carry out their mental actions. This could be possible if the teacher structure learning by connecting their learning experience to the real problems outside the school settings. There are three different ways by which the learners find patterns are

- By immersing learners in complex, interactive experiences that are both rich and real by the teachers.
- By exposing the learners to challenge stimulus so that it stimulate a student's mind to the desired state of alertness.
- By promoting intensive analysis to enable the student to gain insight about a problem, approaching it in different ways to perceive active processing of experience.

Flavell J (1976) suggested that learners engaged in active cognitive structures are able to develop new strategies of thinking ultimately helping them to process the given information. According to Carl Rogers every learner possess natural tendency to learn which should be facilitated by the teacher creating a balance between intellectual and emotional aspect of learning strategy integrating metaphorical thinking technique.

Identifying rules

Metaphorical thinking technique helps the learners to understand the facts by means of mental representation of a group of facts or ideas that somehow belong together. Concepts help us to organize our thinking. When a learner is exposed to a new concept he/she should connect it to the concepts already known. In general, the learner is recommended to follow the following sequential steps:

a) Classifying b) Categorizing c) Recognizing patterns. According to Bernice McCarthy, learning is a process involving the connection between new ideas or the information with the one already known by quick transformation from one cognitive structure to the other helps to understand new information. For example, if a learner may have a definite image in his/her mind of what a four-legged animal which grows horizontally looks like from information he/she has learned from pictures that he/she has been shown, by what he/she has read and by what he/she has been told. When the learner actually encounters a creature that was never seen before, and the creature has all of the qualities of a four-legged animal that has been stored in the brain helps to infer or draw the conclusion that it probably is a dog. Metaphorical thinking creates an image in the mind's eye. The ability to implement metaphorical thinking is a greater skill than understanding those created by others. Hence, a correctly used metaphorical thinking statement indicates that the person understands the subject matter so well that he/she can make another representation of it. This represents concept connection at higher levels. According to Piaget's theory of concept formation a teacher is responsible for developing internal thinking among learners by making them understand the basic concepts of the subject before tackling complex problems by implementing strategies like metaphorical thinking in the lesson plan during teaching learning process. Lakoff and Johnson (1980) pointed out that encouraging metaphorical thinking in the class makes learning experience more meaningful. The link between metaphorical thinking and cognitive structure could be established by the following the sequence of steps while delivering the information: a) questioning b) exploring c) assimilation d) inference and e) reflection as suggested by (Callison 2006). Carol Kuhlthau (1994) mentioned in her research that learners have tendency of uncertainty, optimism, confusion, frustration, doubt, clarity, sense of direction, confidence, relief, and satisfaction or dissatisfaction in seeking pertinent information might result in lack of self-confidence which could be prevented if the teacher inculcates the practice of metaphorical thinking in regular class during teaching/ learning process. Barbara Stripling and Judy Pitts (1980) suggested that the learners develop mental schema (Cognitive structures) when presented with the information by a) recalling b) explaining c) analysing d) challenging e) transforming and synthesizing. Therefore, if each of these steps involves metaphorical thinking technique the transformation from one cognitive structure to the other would enhance reflection and synthesis.

Abstracting principles

One of the most important applications of metaphorical thinking is the development of cognitive structures which quickly transforms to another relevant to the given information resulting in abstract thinking for example if the teacher shows the picture of a dog and cat the student not only understands that he/she is seeing the picture of a four-legged animal that grows horizontally but also count the number of animals. There is a possibility that the learner might be able to associate what he/she has learned from one context to another. For example, a learner by applying metaphorical thinking learns to write an essay in English class is capable of transferring that learning in social studies class. Thus, metaphorical thinking helps the learner to discuss similarities and differences between that which is unfamiliar and distant with the one that is familiar is a commendable way to help learners grasp the abstract concept. Great teachers like Socrates applied metaphorical thinking to facilitate understanding of the concepts systematically through the following hierarchical strategy as shown below:

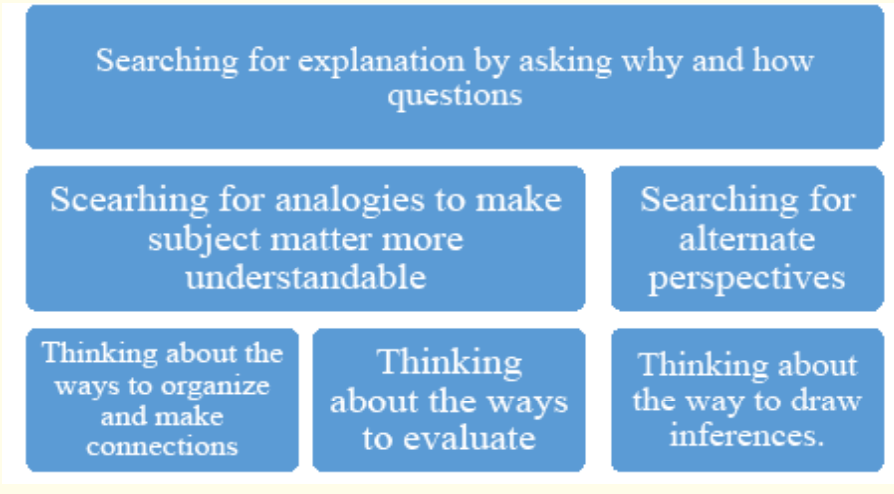


Figure 2: *Shows hierarchical strategies employed to facilitate understanding.*

The strategies mentioned in the model suggest that the teacher imposes them in the sequential order, so that it facilitates the learner to develop ability to construct his/her cognitive structure which would eventually lead to the better understanding of the relevant information.

What is meant by Metaphorical Thinking?

Metaphorical thinking is a soft thinking technique connecting two different universes of meaning. The human mind tends to look for similarities. For e.g. "Time is money" meaning that if you work for more time you earn more money even though time and money are entirely two different things. Practice of metaphorical thinking in understanding given information promotes the communication of the two hemispheres by a bundle of connecting fibres, the corpus callosum at neo cortex level and through hippocampus at the level of limbic system. Hence, metaphorical thinking helps learners to make connections and develop patterns and relationships in parallel to the languages as well as symbols relevant to the given information. Metaphorical thinking initiates' synaptic activity in the axons which in turn enhances co-ordination between right and left hemispheres of the brain thus brings activation in the cerebral cortex enabling quick understanding of the information. Researchers have identified that metaphorical thinking is the ability of an individual to associate the present information with what has already been stored in the memory, by initiating metaphorical thinking practice in teaching –learning process by the teachers during teaching- learning process would enable the learners to optimize their learning ability (Robert S. Siegler and Christopher Shipley, 1995). Another research report by (Lakoff, G. 1993) revealed the usage of metaphorical thinking develops mind patterns which would influence the cognition of the individuals (Miller, 2011) proposed that learners capable of making more associations are proved to be better in understanding the given information through cognitive architecture where the brain senses the information processes it by comparing it with previously stored information (cognitive structure that already exists) transforms to new cognitive structures to store in the long-term memory.

Impact of Metaphorical thinking on teaching- learning process

- Learners generate new ideas analyse and evaluate to identify potential solutions to the given concept.
- By generating and refining ideas, the learners monitor their work and make adjustments as needed. This process would build self-regulation planning, monitoring, and evaluating their own thinking enable them to mould righteous attitude and acquisition of knowledge.
- Develops thinking beyond the given concept thus enable to synthesize and evaluate new knowledge.
- Lead to semantic understanding so that information is stored in long term memory.
- Engages learners in thinking process which in turn develops intrinsic motivation.

Keeping in view the implications of metaphorical thinking in teaching learning process, the present research paper attempts to bring the influence of metaphorical thinking on cognitive structures which in turn playing a key role in enhancing the information processing ability among learners.

Role of metaphorical thinking in developing cognitive structures

Betty Garner [1] suggested that the teachers while teaching everyday lessons to help students develop more effective cognitive structures to learn how to learn so they can make sense of what is taught. For that the teacher should understand that the basic cognitive structures as mental schema that an individual develops in relation to the bits of data to process information for meaning. For example, when an individual is confronted with unfamiliar information the first thing he/she would attempt is to recognize something about it that fits with prior knowledge and experience. As soon as the teacher enters the class, if he/she puts the question "What do you notice?" the teacher is asking them to connect unfamiliar with familiar data. For example, a teacher wishes to teach maths table she/he should initiate the cognitive structure of memorization of tables by showing visual representation as follows

2*1 = 2 is same as the representation of number 2 as one time which is equal to 2

2*2 = 4 is same as the representation of number 2 as two times which is equal to 4

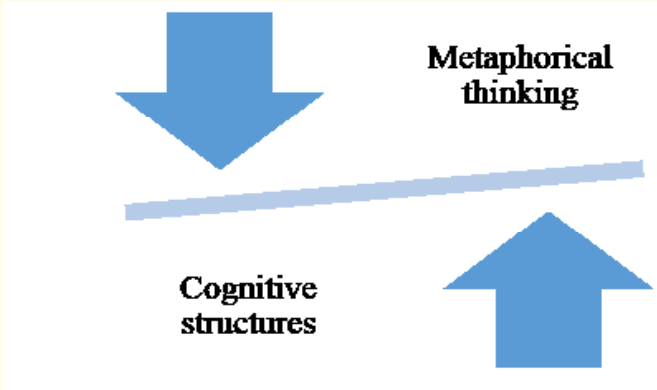
2*3 = 6 is same as the representation of number 2 as three times which is equal to 6

2*4 = 8 is same as representation of number 2 as four times which is equal to 8

The teacher should encourage the learners to process information by comparing how bits of data are alike and different by using the cognitive structure of conservation of constancy similar to the way Jean Piaget demonstrated cognitive constructivism to seven year old children by pouring water into wide mouthed container and transferred the same amount to a narrow mouthed container expecting them to understand that only the shape of the container changed but the volume of the water remained the same. When a teacher teaches characteristics of Carbon compounds he/she should start from the root starting with basic information about its natural existence and comparing its presence in large number of manmade compounds. This comparison would result in the development of cognitive structure Metaphorical thinking enables individuals to think outside the box by comparing bits of information that appear dissimilar but help us to create insights and original thinking. Therefore, thinking metaphorically in a conscious manner develops basic cognitive structures, which operate so automatically that the learners are not even aware of them. On other hand, there are a few students who are incapable of forming effective cognitive structures, such students often drop out of school mentally as early as third grade and survive the upper grades by trying to do just enough to get by or memorizing to pass They should be taught to develop the cognitive structures they need to learn how to learn. Earlier literature has shown the application of metaphors in knowledge development as early in 1990. Strauss, C and Quinn N [2] mentioned the practice of metaphors in understanding complex knowledge and analogical problem solving. Bargh, Barndollar [3] suggested the use of Metaphors consciously in language processing would lead to subconscious activation of goals and motivation. Moser [4] study revealed that metaphorical expressions used in self-concept studies were found to promote cognitive abilities of analogical reasoning [5]. In research study mentioned that metaphorical expressions used by individuals were found to enhance processes of knowledge acquisition and proved to be statistically significant. Lot of scientific evidences are drawn from scientific studies by (Sotillo., *et al*. 2007) indicates that metaphors when used in communication or in language processing makes use of both the hemispheres of the brain for example right hemisphere showed preferential involvement in the processing of insignificant metaphors and the left hemisphere showed preferential involvement for processing salient metaphors. Coulson and Van Petten [6] study on metaphors revealed the involvement of right hemisphere of the brain in processing metaphors as it helps in representing mental schema relevant to the given information thus indicating metaphorical thought process as well as mental schema that is the cognitive structures complement one another. Another instant if a teacher explaining the concept of transportation uses the phrase “A Camel is a desert taxi”. Here the teacher tries to bring the similarity between a taxi and Camel (an animal) used for transportation. The statement initiates a few of the cognitive patterns mentioned below:

- Why Camel is used for transportation only in desert?
- How the animal adapts to the desert condition?
- Why can’t a taxi used in deserts unlike in roads?

These patterns developed in the right hemisphere of the brain helps in processing metaphors [6]. Based on the research studies conducted the following complementary model could be proposed to explain the interdependence of metaphorical thinking and cognitive structures.



The complimentary model involving metaphorical thinking and cognitive structures reveal that implementing metaphorical thinking lesson plan in teaching –learning process develops cognitive structures which would enable a balance brain activity in the left and right hemispheres so that information could be processed with ease.

Researchers have identified that metaphorical thinking is the ability of an individual to associate the present information with what has already been stored in the memory, by initiating metaphorical thinking practice in teaching –learning process by the teachers during teaching- learning process would enable the learners to optimize their learning ability (Robert S Siegler and Christopher Shipley, 1995). Another research report by (Lakoff G 1993) revealed the usage of metaphorical thinking develops mind patterns which would influence the cognition of the individuals (Miller, 2011) proposed that learners capable of making more associations are proved to be better in understanding the given information through cognitive architecture where the brain senses the information processes it by comparing it with previously stored information (cognitive structure that already exists) transforms to new cognitive structures to store in the long-term memory. The Lesson plan implementing Metaphorical thinking would enhance the information processing ability among learners as it builds higher order thinking skills. The learners would be able to understand, apply, analyse, synthesize and evaluate the knowledge presented. The original Bloom's taxonomy of cognitive domain the six cognitive tasks as represented in the following order starting from simpler tasks to complex tasks namely: knowledge, comprehension, application, analysis, synthesis and evaluation. Considering Bloom's taxonomy as the guiding principle an attempt has been made to develop lesson plan in Chemistry for duration of 45 minutes on basic principles namely: Laws of Chemical Combinations, Chemical Formulae, Mole concept etc. The idea is to integrate Metaphorical thinking in every cognitive task mentioned by Bloom.

Lesson Plan implementing Metaphorical thinking

Topic: Laws of Chemical Combination

Std: IX

Duration: 45mins

Curriculum: NCERT

Subject: Chemistry

Learning objectives

At the end of this lesson the pupil

- Recalls the ultimate particle in the universe is atom
- Understands the meaning of the term atom
- Recognizes that atoms are very reactive in nature
- Analyses the fact that atoms combine in small whole numbers
- Applies knowledge to understand Dalton's atomic theory
- Formulates the Laws of Chemical Combination

Specific objectives	Content	Learning Experience	Evaluation
Recalls	Introduction: Teacher introduces the concept of the term atom by explaining the consequences of dividing a known visible object for e.g a chalk to infinite divisions so that it disappears in the air around us but remain as a particle of chalk.	➢ Do you think all objects around you could be reduced to such a small particle that you cannot see? ➢ Can you list out some of the object around you? ➢ Do these objects same or different? ➢ Explain how they are same or different. ➢ Can you come to the conclusion that everything around us could be reduced to such a small particle that we could not see with our eyes?	Define the term atom. List out atomic symbols of few elements known to you.
Recognizes	A teacher explains the fact that when objects could be reduced to atoms the reverse is also possible that atoms combine in a variety of ways to form different compounds.	Do you think that atoms combine in a variety of ways to form large number of compounds? Is this similar Diversity of animal and plant species present in our planet? If atoms combine in a variety of means are they governed by any laws? Don't you think that appropriate laws necessary to govern chemical reactions? Think for a while what will happen if the people living in a society do not abide by the laws.	What are the terms given when atoms of the same element combine as well as atoms of two different elements combine?
Understands	Teacher explains the Daltons atomic theory by stating the postulates. Atoms of the same elements combine in small whole numbers to form molecule whereas atoms of different elements combine small whole numbers to form compounds.	What is the difference between a molecule and a compound? Will the terminology change based on physical state? Under what circumstances a compound addressed as molecule. Is this similar to the way a person is addressed as Miss or Mrs?	Do you think atoms are indivisible? Give reason. Atoms are neither created nor destroyed, do you agree with the statement?
Formulates	Teacher explains the Laws of Chemical combination stating that the mass is always conserved in a chemical reaction. Teacher explains the law of Constant Proportion that in a pure compound atoms of different elements combine in a fixed proportion by weight.	What is meant by conservation of mass? Is similar to flower converting to fruit? What is the difference between a chemical changes in which the mass is conserved whereas conversion of flower to fruit mass is not conserved? How do you explain the conservation of mass in these two cases? What is meant by fixed propitiation by mass? Does it have any connection with various delicious recopies that chef makes? What would happen when the ingredients in the recipe is mixed in correct proportion. An excellent chef always maintains the same consistency how many times he repeats the recipe is it true? What connection the above-mentioned statement similar to that atom of elements always combine in a definite ratio?	State the law of conservation of mass. What is the significance of balancing the chemical reaction? State law of constant proportion. Illustrate the law with a few examples. Attempt illustrating the law with various combinations of elements.

Assessment

Consider for example water a pure compound formed from the two elements Hydrogen and Oxygen, in what proportion the two elements combine?

Will the proportion by weight of the elements remain same or different, if a sample of water is collected from different sources?

Consider a few other examples of pure compound like Carbon Dioxide, Sulphur Dioxide, Ammonia, Methane etc. and find out the proportion by weight of the elements combine?

What conclusion do you arrive about law of constant proportion?

Is the statement of law is in accordance to the fixed composition of the elements found in naturally occurring compounds like sugar and common salt, the most important ingredients in everyday life?

Methodology

A survey was conducted on 1154 male and female school teachers teaching Science in the secondary schools. Cognitive structure evaluation questionnaire prepared by the investigator based on content, activity and assessment was administered to the teachers. The questionnaire consisted of 45 statements with 15 statements based on content, activity and assessment each statement is based on the use of metaphorical thinking as main objective. Three types of schools were involved in the survey namely: Government, Government aided and Private schools. The teachers were asked to read each statement carefully and tick the appropriate option. The responses were collected and the statistical analysis were carried out on the scores.

Objectives of the study

- To find out whether there is any variation in the extent of evaluation of cognitive structures among the teachers working in the three types of schools.
- To find out whether there is significant difference among the teachers in these three types of schools in planning the content, activity and assessment to develop cognitive structures.
- To find out if there is significant difference in the development of the cognitive structures based on content, activity and assessment in relation to the teacher's age.

Research Questions

- Do the type of schools determine the ability of teachers in planning the content, activity and assessment of a lesson to develop cognitive structures?
- Does the teacher's age play an important role in determining the extent of developing the cognitive structures?

In order to find the objectives as well as to answer the research questions ANOVA was carried out and the results are tabulated as follows.

The results of table 1 shows that the teachers working in different types of schools show significant variation in preparing the lesson plan implementing metaphorical thinking.

Dimensions of cognitive structures	Type of school	N	Mean	S.D	"F"	Level of significance
Content	Public school (state)	952	62.15	7.82	6.96	0.00
	Public school Funded (State)	75	63.32	7.40		
	Public school (Centre)	45	64.31	6.92		
	Others	77	64.53	6.37		
Activity	Public school (State)	952	56.88	7.85	8.37	0.00
	Public school Funded (State)	75	58.84	8.08		
	Public school (Centre)	45	58.62	8.87		
	Others	77	60.04	8.54		
Assessment	Public school (State)	952	53.76	7.80	7.90	0.00
	Public school funded(State)	75	56.88	8.93		
	Public school (Centre)	45	55.51	6.98		
	Others	77	57.25	10.10		

Table 1: *Shows that there is significant variation shown among the teachers working in different categories of schools.*

Table 2 shows that in group 1 vs group 4 there is significant variation in preparing the lesson plan based on activity and assessment compared to rest of the groups.

Dimensions of cognitive structures	Age of teachers (years)	Comparison between age groups	N	Tuckey- HSD: Showing group variation	Mean difference between the groups	L.S
Content	Public School (State)	Group 1	192	Group 1 vs Group 2	-1.17	0.58
	Public School funded (State)	Group 2	570	Group 1 vs Group 3	-2.16	0.25
	Public School (Centre)	Group 3	350	Group 1 vs Group 4	-2.38	0.04
	Others	Group 4	32			
Activity	Public School (State)	Group 1	192	Group 1 vs Group 2	-1.96	0.17
	Public School funded (State)	Group 2	570	Group 1 vs Group 3	-1.74	0.48
	Public School (Centre)	Group 3	350	Group 1 vs Group 4	-3.16	0.00
	Others	Group 4	32			
Assessment	Public School (State)	Group 1	192	Group 1 vs Group 2	-3.11	0.00
	Public School funded (State)	Group 2	570	Group 1 vs Group 3	-1.75	0.48
	Public School (Centre)	Group 3	350	Group 1 vs Group 4	-3.48	0.00
	Others	Group 4	32			

Table 2: *Shows the comparison between group 1 with 2, 3, and 4 in drafting content, activity and assessment of the lesson plan with respect to different categories of school.*

Table 3 shows that there is significant variation in preparing the lesson plan with respect to assessment in group 2 vs group 1 compared to the rest of the groups.

Dimensions of cognitive structures	Age of teachers (years)	Comparison between age groups	N	Tuckey- HSD: Showing group variation	Mean difference between the groups	L.S
Content	Public School (State)	Group 1	192	Group 2 vs Group 1	1.17	0.58
	Public School funded (State)	Group 2	570	Group 2 vs Group 3	-0.99	0.90
	Public School (Centre)	Group 3	350	Group 2 vs Group 4	-1.21	0.76
	Others	Group 4	32			
Activity	Public School (State)	Group 1	192	Group 2 vs Group 1	1.96	0.17
	Public School funded (State)	Group 2	570	Group 2 vs Group 3	0.22	0.10
	Public School (Centre)	Group 3	350	Group 2 vs Group 4	-1.20	0.79
	Others	Group 4	32			
Assessment	Public School (State)	Group 1	192	Group 2 vs Group 1	3.11	0.00
	Public School funded (State)	Group 2	570	Group 2 vs Group 3	1.37	0.80
	Public School (Centre)	Group 3	350	Group 2 vs Group 4	-0.37	1.00
	Others	Group 4	32			

Table 3: *Shows the comparison between group 2 with 1, 3, and 4 in drafting content, activity and assessment of the lesson plan with respect to different categories of school.*

Table 4 shows that there is no significant variation in preparing the lesson plan with respect to content, activity and assessment of group 3 vs rest of the groups.

Dimensions of cognitive structures	Age of teachers (years)	Comparison between age groups	N	Tuckey- HSD: Showing group variation	Mean difference between the groups	L.S
Content	Public School (State)	Group 1	192	Group 3 vs Group 1	2.16	0.25
	Public School funded (State)	Group 2	570	Group 3 vs Group 2	0.99	0.90
	Public School (Centre)	Group 3	350	Group 3 vs Group 4	-0.22	1.00
	Others	Group 4	32			
Activity	Public School (State)	Group 1	192	Group 3 vs Group 1	1.74	0.48
	Public School funded (State)	Group 2	570	Group 3 vs Group 2	-0.22	1.00
	Public School (Centre)	Group 3	350	Group 3 vs Group 4	-1.42	0.82
	Others	Group 4	32			
Assessment	Public School (State)	Group 1	192	Group 3 vs Group 1	1.75	0.48
	Public School funded (State)	Group 2	570	Group 3 vs Group 2	-1.37	0.80
	Public School (Centre)	Group 3	350	Group 3 vs Group 4	-1.74	0.66
	Others	Group 4	32			

Table 4: *Shows the comparison between group 3 with 1, 2, and 4 in drafting content, activity and assessment of the lesson plan with respect to different categories of school.*

Dimensions of cognitive structures	Age of teachers (years)	Comparison between age groups	N	Tuckey- HSD: Showing group variation	Mean difference between the groups	L.S
Content	Public School (State)	Group 1	192	Group 4 vs Group 1	2.38	0.04
	Public School funded (State)	Group 2	570	Group 4 vs Group 2	1.21	0.76
	Public School (Centre)	Group 3	350	Group 4 vs Group 3	0.22	1.00
	Others	Group 4	32			
Activity	Public School (State)	Group 1	192	Group 4 vs Group 1	3.16	0.00
	Public School funded (State)	Group 2	570	Group 4 vs Group 2	1.20	0.79
	Public School (Centre)	Group 3	350	Group 4 vs Group 3	1.42	0.78
	Others	Group 4	32			
Assessment	Public School (State)	Group 1	192	Group 4 vs Group 1	3.48	0.00
	Public School funded (State)	Group 2	570	Group 4 vs Group 2	0.37	0.99
	Public School (Centre)	Group 3	350	Group 4 vs Group 3	1.74	0.66
	Others	Group 4	32			

Table 5: *Shows the comparison between group 4 with 1, 2, and 3 in drafting content, activity and assessment of the lesson plan with respect to with respect to different categories of school.*

Table 6 shows that there is no significant variation in preparing the lesson plan based on activity of the sample with respect to their age.

Dimensions of cognitive structures	Age of teachers	N	Mean	S.D	"F"	L.S
Content	25 - 35 years	192	64.17	6.96	6.17	0.001
	35 - 45 years	570	62.59	7.49		
	45 - 55 years	350	61.29	8.28		
	55 - 65 years	32	63.41	6.15		
Activity	25 - 35 years	192	57.73	7.74	1.24	0.295
	35 - 45 years	570	57.44	8.10		
	45 - 55 years	350	56.72	8.14		
	55 - 65 years	32	58.78	5.40		
Assessment	25 - 35 years	192	54.80	6.91	4.13	0.008
	35 - 45 years	570	54.88	8.18		
	45 - 55 years	350	53.03	8.55		
	55 - 65 years	32	54.16	6.07		

Table 6: *Shows the variation in different age groups in planning the content, activity and assessment of a lesson.*

Table 7 to 10 reveals that there is significant variation in preparing the lesson pan based on content among the teachers in the group 1 vs group 3 compared to the rest of the groups.

Dimensions of cognitive structures	Age of teachers (years)	Comparison between age groups	N	Tuckey-HSD: Showing group variation	Mean difference between the groups	L.S
Content	25 - 35	Group 1	192	Group 1 vs Group 2	1.58	0.06
	35 - 45	Group 2	570	Group 1 vs Group 3	2.88	0.00
	45 - 55	Group 3	350	Group 1 vs Group 4	0.77	0.95
	55 - 65	Group 4	32			
Activity	25 - 35	Group 1	192	Group 1 vs Group 2	0.29	0.97
	35 - 45	Group 2	570	Group 1 vs Group 3	1.01	0.49
	45 - 55	Group 3	350	Group 1 vs Group 4	1.05	0.90
	55 - 65	Group 4	32			
Assessment	25 - 35	Group 1	192	Group 1 vs Group 2	0.09	1.00
	35 - 45	Group 2	570	Group 1 vs Group 3	1.76	0.07
	45 - 55	Group 3	350	Group 1 vs Group 4	0.64	0.98
	55 - 65	Group 4	32			

Table 7: *Comparing the variation between the group 1 with groups 2, 3, 4 in drafting the content, activity and assessment of a lesson plan with respect to the age group of teachers.*

Dimensions of cognitive structures	Age of teachers (years)	Comparison between age groups	N	Tuckey - HSD: Showing group variation	Mean difference between the groups	L.S
Content	25 - 35	Group 1	192	Group 2 vs Group 1	1.58	0.06
	35 - 45	Group 2	570	Group 2 vs Group 3	1.29	0.06
	45 - 55	Group 3	350	Group 2 vs Group 4	0.82	0.93
	55 - 65	Group 4	32			
Activity	25 - 35	Group 1	192	Group 2 vs Group 1	0.29	0.97
	35 - 45	Group 2	570	Group 2 vs Group 3	0.73	0.54
	45 - 55	Group 3	350	Group 2 vs Group 4	- 1.05	0.79
	55 - 65	Group 4	32			
Assessment	25 - 35	Group 1	192	Group 2 vs Group 1	0.09	1.00
	35 - 45	Group 2	570	Group 2 vs Group 3	1.85	0.00
	45 - 55	Group 3	350	Group 2 vs Group 4	0.73	0.96
	55 - 65	Group 4	32			

Table 8: *Comparing the variation between the group 2 with groups 1, 3, 4 in drafting the content, activity and assessment of a lesson plan with respect to the age group of teachers.*

Dimensions of cognitive structures	Age of teachers (years)	Comparison between age groups	N	Tuckey-HSD: Showing group variation	Mean difference between the groups	L.S
Content	25 - 35	Group 1	192	Group 3 vs Group 1	- 2.88	0.00
	35 - 45	Group 2	570	Group 3 vs Group 2	- 1.29	0.06
	45 - 55	Group 3	350	Group 3 vs Group 4	- 2.11	0.44
	55 - 65	Group 4	32			
Activity	25 - 35	Group 1	192	Group 3 vs Group 1	- 1.02	0.49
	35 - 45	Group 2	570	Group 3 vs Group 2	- 0.73	0.54
	45 - 55	Group 3	350	Group 3 vs Group 4	- 2.06	0.50
	55 - 65	Group 4	32			
Assessment	25 - 35	Group 1	192	Group 3 vs Group 1	- 1.76	0.07
	35 - 45	Group 2	570	Group 3 vs Group 2	- 1.85	0.00
	45 - 55	Group 3	350	Group 3 vs Group 4	- 1.12	0.87
	55 - 65	Group 4	32			

Table 9: *Comparing the variation between the group 3 with groups 1, 2, 4 in drafting the content, activity and assessment of a lesson plan with respect to age group of teachers.*

Dimensions of cognitive structures	Age of teachers (years)	Comparison between age groups	N	Tuckey-HSD: Showing group variation	Mean difference between the groups	L.S
Content	25 - 35	Group 1	192	Group 4 vs Group 1	- 0.77	0.95
	35 - 45	Group 2	570	Group 4 vs Group 2	0.82	0.93
	45 - 55	Group 3	350	Group 4 vs Group 3	2.11	0.44
	55 - 65	Group 4	32			
Activity	25 - 35	Group 1	192	Group 4 vs Group 1	1.05	0.90
	35 - 45	Group 2	570	Group 4 vs Group 2	1.34	0.79
	45 - 55	Group 3	350	Group 4 vs Group 3	2.06	0.50
	55 - 65	Group 4	32			
Assessment	25 - 35	Group 1	192	Group 4 vs Group 1	- 1.64	0.98
	35 - 45	Group 2	570	Group 4 vs Group 2	- 1.73	0.96
	45 - 55	Group 3	350	Group 4 vs Group 3	1.12	0.87

Table 10: *Comparing the variation between the group 4 with groups 1, 2, 3 in drafting the content, activity and assessment of a lesson plan with respect to the age group of teachers.*

Results

From the statistical calculations, it is understood that the teachers working in schools following C.B.S.E schools showed better competence in planning the lesson plan based on three dimensions. The post hoc test also revealed that the type of schools plays an important role in determining the planning of the lesson. Secondly age of the teachers in another determining factor in planning the lesson. In general, the results reveal that the teachers in the age group 25 to 35 years being the beginning of their professional career show interest in planning the lesson in comparison to the other age groups.

Discussions

Liberato Cardellini [7] research on acquiring and assessing structural representation of knowledge revealed that the students were able to effectively construct the knowledge by practicing two learning tools namely: concept maps and word association test. Mojca Jurisevic [8] proposed cognitive and motivational methods of teaching to regulate the learning behaviour of the students and lays emphasis on stimulation of creative thinking at school to ensure active learning, high level thinking and innovative achievements. which hinges on understanding the dynamics of motivation regulating pupils' learning behaviours. She discusses two levels of teaching, the cognitive and the motivational, which in the optimal proportions ensure the conditions for activating learners' higher-level thinking processes, which are a basis for creative thinking that leads to innovative achievements. Whyte, Greenwood and Lazes [9] proposed a real-life practice situations to train chemistry teachers so that they could motivate the learners to develop a sense of constructive rethinking of their ideas. Zhao [10] suggested that to involve the students in active learning in 21st century class rooms, it is the responsibility of the teachers to foster creativity, new skills and knowledge needed for the living in the global world as well as in the virtual world. Research education and design lab in Stanford introduced design thinking analogous to metaphorical thinking in which teachers encourage activities associated to creative thinking which stimulates the learner's ability to think in a divergent pattern [11,12].

Conclusions

Cognitive structures play an important role in the information processing ability of the learners as they serve as frames of reference, allow grasping and working with one or several aspects of a concept. Therefore, teacher plays an important role in facilitating the learners to develop mental representations by illustrating the content with graphical representation, visualization of diagrams as well as through symbolic and abstract thinking. Greater is the number of illustrations greater is the mental representation and quicker is the information processing ability of the individuals. A mental representation depends on individual's capacity to "concretely" represent a concept to one self by several mental frames of reference. Therefore, it could be very well said that implementing metaphorical thinking lesson-plan establishes a quick building of cognitive structures based on the content, activity and assessment in the form of interlocking the sequences enabling the learner to process the information.

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