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## Is Metaphorical thinking related to development of Cognitive structures among learners?

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### ABSTRACT

Cognitive structures are the basic mental pattern people use to process any information. Alternatively cognitive structures include *mental structures*, *mental tools*, and *patterns of thought*. Metaphorical thinking being one of the mental tool present innate in human being which when practiced consciously could help developing cognitive structures in turn help to process information. It is very important to note that each individual has to develop his/her own cognitive structures by means of practice of Metaphorical thinking as mental tool through good teaching/learning practices similar to an athlete involved in rigorous physical training to meet the challenge of the competition. The present paper explains the influence of metaphorical thinking as a mental tool in determining the cognitive structures based on content, activities and assessment of the given information passed from teachers to students during teaching-learning process.

**Keywords:** Metaphorical thinking; Mental Structure; Patterns of thought; Abstracting Principles; Mental tools; Patterns of thought and Cognitive Structures

### 1. INTRODUCTION

#### 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 analyze 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 (2012) 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. & Quinn, N. (1997) mentioned the practice of metaphors in understanding complex knowledge and analogical problem solving.

Bargh, Barndollar (1996) suggested the use of Metaphors consciously in language processing would lead to subconscious activation of goals and motivation. Moser (1998) study revealed that metaphorical expressions used in self concept studies were found to promote cognitive abilities of analogical reasoning. (Moser, et al 2000) 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 & Van Petten, (2007) 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

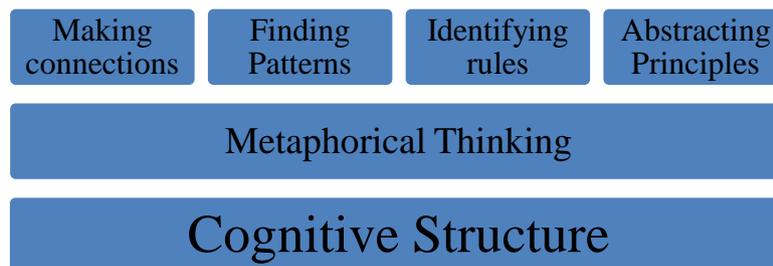
mental schema that is the cognitive structures complement one another. Another instant if a teacher explaining the concept of transportation uses the phrase “A Camel is a desert taxi”. Here the teacher tries to bring the similarity between a taxi and Camel (an animal) used for transportation. The statement 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 (Coulson & Van Petten, 2002).

### **What is meant by Cognitive Structure?**

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.

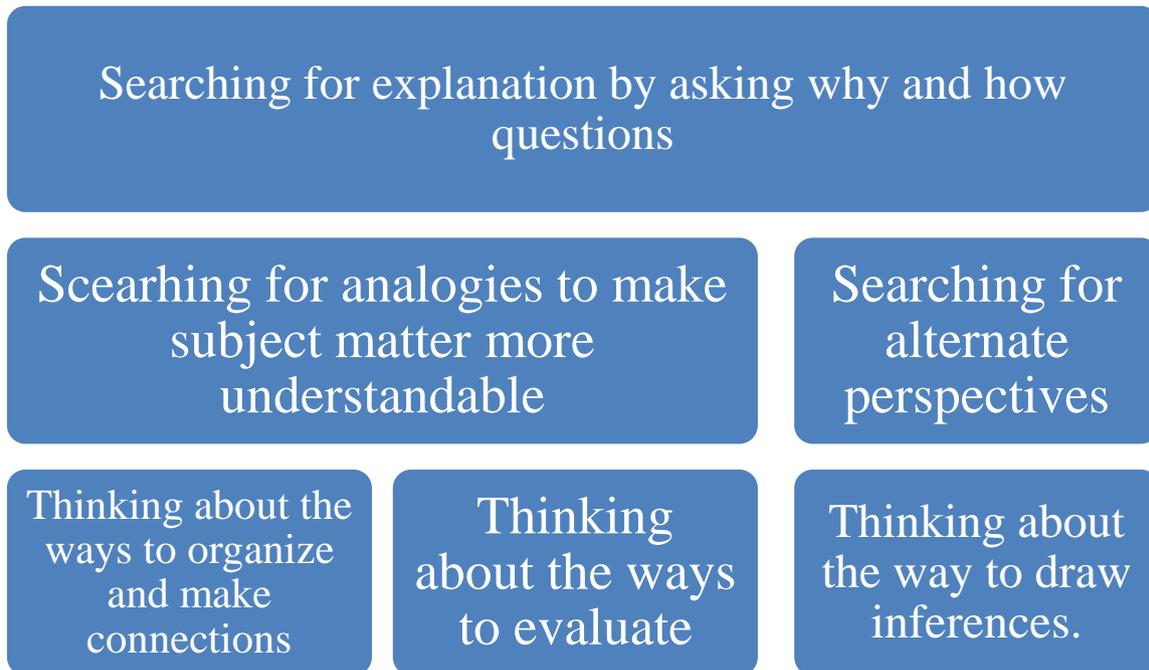
The ability to implement metaphorical thinking is a greater skill than understanding those created by others. Hence, a correctly used metaphorical thinking statement indicates that the person understands the subject matter so well that he/she can make another representation of it. This represents concept 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.

### **Objectives of the Study**

- To find the implementation of metaphorical thinking on the development of cognitive structures improves the information processing ability.
- To find the relationship between various dimensions of cognitive structure and its link to metaphorical thinking.

### **Research Questions**

- What is the role of metaphorical thinking enhancing information processing ability?
- How metaphorical thinking is linked to the formation of cognitive structures?

## Research Instrument

A cognitive structure formation evaluating questionnaire consisting of 45 statements based on four dimensions namely (1) making connections, (2) finding patterns, (3) identifying rules, and (4) abstracting principles was prepared relevant to content, activity and assessment. A pilot study was conducted on a sample of 100 teachers. The reliability was calculate by using split half split method was found to be 0.756 and the validity of the questionnaire was calculated as the square of reliability equal to 0.585.

## 2. METHODOLOGY

Survey method was used to find the inclination of the teachers implementing metaphorical thinking in regular class room teaching /learning process. The sample consists of 100 teachers in the age group 25 to 45 years were selected for the study. A questionnaire consisting of 45 statements to evaluate Cognitive Structure on content, activity and assessment was administered. The aim of the study is to find how the teachers implementing metaphorical thinking based on four dimensions mentioned earlier help in the development of cognitive structures enhance the information processing ability. The scores of questionnaire were subjected to regression analysis.

## 3. RESULTS

**Table 1.** To show the relationship between metaphorical thinking (made of four components) with content, activity and assessment.

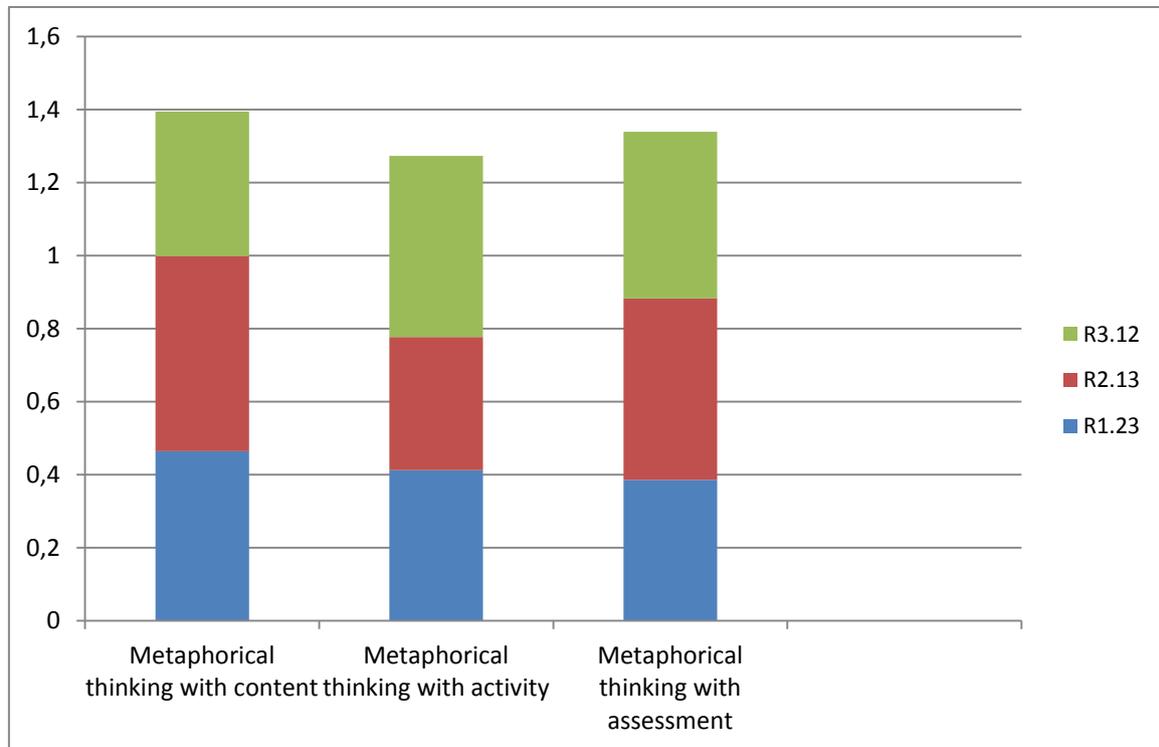
S. No	Psychological variable	R <sub>1.23</sub>	R <sub>2.13</sub>	R <sub>3.12</sub>	Level of significance
1	Metaphorical thinking with content	0.464**	0.534**	0.397*	0.05
2	Metaphorical thinking with activity	0.412**	0.365*	0.496	0.05
3	Metaphorical thinking with assessment	0.386*	0.497**	0.456**	0.05

\*p < 0.05, \*\*p < 0.01, \*\*\*p < 0.001, N.S = Not significant.

R<sub>1.23</sub> = the relationship of metaphorical thinking with content, activity and assessment.

R<sub>2.13</sub> = the relationship of metaphorical thinking with activity content and assessment.

R<sub>3.12</sub> = the relationship of metaphorical thinking with assessment, content and activity.



**Figure 3.** Show the relationship between Metaphorical thinking with content, activity and assessment.

#### 4. FINDINGS

The result showed the content when presented in the form that it establishes connection between prior to present knowledge as well as finding patterns showed strong relationship to Metaphorical thinking as well as abstracting principles by asking though provoking questions. The overall regression values suggests that if the information is delivered by the teacher by careful planning of the content, activity and assessment establishing the link between present to the prior knowledge, finding patterns, identifying rules and abstracting principles would result in quick development of cognitive structures eventually resulting in the enhanced information processing ability. The regression analysis values show the interdependence of the three dimensions that is activity, content and assessment. Therefore, while delivering the lesson it is necessary that the teacher has to consciously plan how to prepare the instructional material implementing metaphorical thinking statements.

#### 5. DISCUSSIONS

Passolunghi, M. C., Mammarella, I. C., & Atoe, G (2008) in their study suggested that the teachers should try to make interventions and accommodations for their students by implementing strategies that would help in better understanding of the information. Piaget suggested in his cognitive development model that the student takes new information and

assimilate it into their existing schema without making any changes to the overall schema , secondly the learner ones realizes that the existing schema is inadequate for the new information, he/she tries to modify the existing schema through restructuring. Miller (2002), study pointed out that for learners in order to effectively process information, their existing schemas related to the new information need to be activated. This could be done by using outlines, organized activities, advanced organizers, meaningful materials such as handouts, guides, asking specific questions, etc.

This activation stimulates prior knowledge and, in turn, students are better able to process the new information and link to it. Armbruster, (1996). Study suggested that the teachers need to be encouraged to use analogies and comparisons in their teaching/ learning process in order to draw attention to students' existing schemas and to help them make connections between existing schemas and new information. From the above discussion it could concluded that metaphorical thinking forms a link between the cognitive structure development through (1) making connections, (2) finding patterns, (3) identifying rules, and (4) abstracting principles. Another study conducted by Paul H. Thibodeau, Lera Boroditsky (2011) had mentioned that the role of metaphorical thinking in guiding the people to reason about the complex problem of crime in police force. Further found that metaphors exert an influence over people's reasoning by instantiating frame-consistent knowledge structures, and inviting structurally-consistent inferences.

The significance of cognitive structure was mentioned in a study by Drisoll, M. P. (2000), according to their view carefully planning the instructional design strictly keeping in view to meet the learning objectives of the given concept with the use of metaphors and analogies to relate meaning of the new information to prior knowledge would initiate the internal mechanism of human thought in integrating the incoming information with the existing knowledge structures. Another study by Lewis & Smith, 1993 showed that by interlinking thinking activities with content through “elaborating the given material, making inferences explicitly focusing on similarities, building adequate representations, analyzing would increase learner’s ability to understand the given information developing relevant thought process. Kauchak & Eggen, 1998 pointed out that the teacher by considering the strength and weakness of his/ her learners to accommodate strategy that involves variety of examples to describe the thinking processes by providing additional examples and explanations.

## **6. CONCLUSIONS**

Teacher practicing metaphorical thinking skills to explain the given information require particular clarity of communication to reduce ambiguity and confusion and improve student attitudes about thinking tasks. Lesson plans should include modelling of thinking skills, examples of applied thinking, and adaptations for diverse student needs. The teacher should help the student to apply what is taught in one context to generalize in other contexts so that the student develops a concrete knowledge of the given information. Therefore, Cognitive structures could be developed by practicing Metaphorical thinking by following ways.

- ❖ Making connections with prior knowledge and experience and by sharing the experience to the learning situation.

- ❖ Looking for patterns and relationships among bits of information to integrate and make meaning.
- ❖ Formulating rules to process information quickly and automatically.
- ❖ Abstracting generalizable principles to transfer learning from one situation to another.
- ❖ Promoting learning by comparison by structurally aligning the given information to develop appropriate mental schema.
- ❖ Providing field experience relevant to the content so that the student initiates his/her own thinking to compare the real and virtual experience.
- ❖ Promoting observation among learners that is the instructional material to be designed in such manner that the student develops the ability to observe, compare and acquire knowledge by mental representations.
- ❖ Implementing the practice of thought provoking questions related to the qualitative and quantitative nature of the content.
- ❖ Promoting learning activities that connect to prior experience.
- ❖ Promoting reflective thinking among learners helps in developing cognitive structures.

Right from the time Aristotle the role of Metaphors in language acquisition is a well known fact supported by a number of research studies conducted throughout the world. The present research paper attempts to explain the implementation of metaphorical thinking statements in teaching-learning process consciously by the teacher would bring revolution the teaching /learning strategy by actively involving the learners in their own thought process. One of the main challenges that the teacher encounters is to engage the learners in the classroom. Therefore, to counter this challenge the teacher has to adopt a method through which the learners could be engaged is by implementing metaphorical thinking by a variety of strategies mentioned earlier so that the students are involved in active learning. This would promote a careful reflection as well as retrospection about one's own cognitive structure or an analytical comparison with other's cognitive structures would enable the individual learners to construct a more integrated and sound knowledge structure for further applications .

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