Chapter - II

Conceptual Frame Work
2.1 INTRODUCTION

This chapter on conceptual framework deals with the concepts and theories related to the variables selected for present study. It offers a frame of reference and a focus on concept formation, logical reasoning, styles of thinking, models of teaching, Inductive Thinking Model and its nurturant effects such as awareness to nature of knowledge and sensitivity to language. Based on the concepts the researcher planned and designed her research study by formulating hypotheses, implementing suitable teaching learning strategies and testing the hypotheses to realize the objectives of her study.

2.2 THINKING AND REASONING

The cognitive abilities like thinking and reasoning are the chief characteristics of human beings. The challenges and problems faced by the individual or society may solve through some serious efforts involving thinking and reasoning. Training young people to think is often given as one of the primary aims of education. The most frequent pieces of advice offered to students are the admonition to ‘think clearly’ or ‘think things through’. It is important to just what children do when they think and what distinguishes clear from unclear thinking. No education is worth the name if it does not include among its objectives, the development of children’s capacity for independent thinking and reasoning.

2.2.1 Thinking

Thinking is defined by Garret (1975) as ‘a behavior which is often implicit or inner, in the sense of not being readily observable. It is carried on by slight
muscular movements and by mental images representing a variety of 'symbols'. Gilmer defines that thinking is a problem solving process in which we use ideas or symbols in place of overt activity. These definitions explain that thinking is a process of internal representation of external events of past, present and future. Hence it refers to a pattern of behavior in which man make use of internal representations such as symbols and signs of the things and events for the solution of some specific purposeful problem.

2.2.2 Nature of Thinking

1. Thinking is essentially a cognitive activity.
2. It is always directed towards to achieve some end or purpose.
3. Thinking is described as a problem solving behavior. There is some problem around which the whole process of thinking revolves. However, not every problem solving behavior is thinking. It is only related to cognitive behavior.
4. Thinking is a symbolic activity. In thinking, there is a mental solution of the problem, which is carried out through some signs, symbols and mental images.
5. Thinking can shift very rapidly, covering an expanse of time and space.

2.2.3 Tools of Thinking (Elements of thought)

The various elements involved in the thinking process are images, concepts, symbols, signs, language, muscular activities and brain functions. Images as ‘mind pictures’ consists of personal experiences of objects, persons or scenes, once actually seen, heard or felt. In thinking, man manipulates the images instead of actual objects, experiences or activities. The concepts as a tool economies our efforts in thinking. Concept is a general idea that stands for a general class and represents the common property of all the objects or events of this general class. Symbols and signs represent as substitutes for actual objects, experiences and activities. These symbols and signs stimulate and economies thinking. Language is the most efficient and development vehicle used for carrying out the process of
thinking. When one listens, reads, writes words, phrases or sentences, or observes
gesture in any language, he is said to be stimulated to think.

Muscular activities are also found to be the tools of thought. A high positive
correlation has been found to exist between the thinking and muscular activities of
an individual. Whatever may be the role of muscles, thinking is primarily a function
of our brain. The mind or brain is said to be the chief instrument or reservoir for
carrying out the process of thinking. The mental pictures or images can be stored,
formed, reconstructed or put to make use only through the functioning of the brain.
Therefore, what happens in thought process can simply be called a game, function
or product of the activities of brain.

Thinking is largely affected by the inducement of sets. What goes previously
in perception or experience makes the base for present and future thinking. The set
that has been gained from previous experiences, surely interfere with subsequent
thinking behavior.

2.2.4 Types of thinking

S. K. Mangal says in his book General Psychology (1996) that thinking, as a
mental process is usually classified into the following types:

2.2.4.1 Perceptual thinking or concrete thinking

It is the simplest form of thinking. Interpretation of sensation according to
one’s experience forms the basis of it. It is also named as concrete thinking as it is
carried over the perception of actual or concrete objects and events.

2.2.4.2 Conceptual or Abstract thinking

It does not require the perception of actual objects or events. It is an abstract
thinking where one makes use of concepts, the generalized ideas and language. It is
regarded as a superior type of thinking to perceptual thinking as it economics efforts
in understanding and problem solving.
2.2.4.3 Reflective thinking

It is somewhat of a higher form of thinking. It can be distinguished from simple thinking in the following ways:

a. It aims at solving complex problems rather than simple problems.

b. It requires re-organization of all the relevant experience and finding new ways of reacting to a situation or of removing an obstacle instead of simple association of experience or ideas.

c. Mental activity in reflective thinking does not undergo any mechanical ‘trial and error’ type of effort. There is an insightful cognitive approach in reflective thinking.

d. It takes logic into account in which all the relevant facts are arranged in a logical order, in order to get the solution of the problems in hand.

2.2.4.4 Creative thinking

This is chiefly aimed at creating something new. It is in search of new relationship and association to describe and interpret the nature of things, events and situations. It is not bound by any pre-established rules. The individual himself, usually, formulates the problems and he is free to collect evidence and to invent tools for its solution. The thinking of the scientists or inventors is an example of creative thinking.

2.2.4.5 Non directed or Associative thinking

Thinking without goals is non-directed one. It is reflected through day dreaming, dreaming, free association, fantasy, delusion and other flowing uncontrolled activities. Fantasy and day dreaming, can prove quite constructive by providing opportunities for building cognitive and creative skills and helping in problem solving behavior. Delusions, characterizing abnormalities in behavior, may be defined as persistent thoughts or false beliefs, which the individual defends vigorously by believing them to be true, despite logical proof to the contrary and
despite their serious interference with his social adjustment. The individual suffering from delusions never stand for the correction in his thoughts or beliefs by an appeal to reason.

2.2.5 Reasoning

Reasoning plays a significant role in adjusting to one’s environment. It controls not only one’s cognitive activities, but also the total behavior. The personality is affected by its proper or improper development of one’s reasoning ability. Reasoning like thinking involves a definite purpose or goal and problem solving behavior. There is mental exploration instead of motor exploration in reasoning as it explores mentally the reason or cause of an event or happening. Like thinking, reasoning is a highly symbolic function. The ability to interpret various symbols to the development of concepts with linguistic ability helps much in reasoning. Reasoning is said to be a typical thinking a productive and advanced stage in the complex process of one’s thinking.

Garret defines, ‘Reasoning is step wise thinking with a purpose or goal in mind’. Woodworth explains that in reasoning items (facts or principles) furnished by recall, present observation and both are combined and examined to see what conclusion can be drawn from the combination.

Skinner says, ‘Reasoning is the word used to describe the mental recognition of cause and effect relationship. It may be the prediction of an event from an observed cause or the inference of a cause from an observed event’.

A close analysis of above definitions reveals that reasoning derives a higher order thinking which is quite careful, systematic and organized in its functioning. Dewey analyses it in five steps such as,

1. Identification of the goal or purpose for which reasoning is to be directed.
2. The mental exploration or search for the various possibilities, cause and effect relationships or situations for realizing the set goal or purposes based on previous learning or experiences and present observations or attempts.

3. Selection of the most appropriate possibility or solution by careful mental analysis of all the available alternatives.

4. Testing the validity of the selected possibility or solution, purely through mental exercise and thus finally accept or reject it for the actual solution of the problem.

2.2.6 Types of Reasoning

Reasoning classified into two types: 1) Inductive and 2) Deductive reasoning.

2.2.6.1 Inductive Reasoning

Induction is a way of proving a statement or generalizing a rule or principle by proving or showing that if a statement or a rule is true in one particular case, it will be true in cases, which appear in some serial order, and thus it may be applied generally to all such type of cases. Therefore, by starting from particular facts or special examples and instances one can formulate generalized principles and conclusions in this type of reasoning. Inductive reasoning is called ‘Bottom up’ approach, moving from specific observations and measures to detect patterns and regularities, formulate some tentative hypotheses that can explore and end up developing general conclusions or theories.

2.2.6.2 Deductive Reasoning

It is just opposite to Inductive reasoning. It works from more general to more specific. One starts completely agreeing with some already discovered or pre-established generalized fact or principle and tries to apply it to particular cases. Therefore, it is called “top down” approach.
These two methods of reasoning have different ‘feel’ while conducting research. Inductive reasoning is more opening ended and exploratory, especially at the beginning. While deductive reasoning is narrower in nature and is confirming hypotheses. In this research, the investigator uses Inductive method with a few observed facts, tries to observe some common elements in them, forms hypotheses about their explanation; verify those hypotheses for final acceptance or rejection.

2.3 COGNITIVE DEVELOPMENT

Cognition refers to mental activity including thinking, remembering, learning and using the understanding of information and concepts. If the teachers are able to understand the connections between concepts, to break down information and to rebuild with logical connections, then the effect of teaching and learning will increase. Gestaltists focus upon insight and define it as ‘the sudden perception of relationships among elements of a problem situation’, (Lerancois 1972) cognitive theorists view ‘learning as a process of recognition. The learner perceives new relationship among the parts of problem’. Researchers who contributed significantly to the development of cognitive psychology include Jerome Bruner, who developed a learning theory based upon categorization and David Asubel, who
attempted to explain meaningful verbal learning as a phenomenon of consciousness rather than of behavior.

Cognitive theory maintains that how one ‘thinks’ largely determines how one ‘feels’ and ‘behaves’. This relates and incorporates to all forms of knowing including memory, psycholinguistics, thinking, comprehension, motivation and perception. According to Kate McGilly (1996), students are not learning to their full potentials because more often than not, they use rote memory procedures in the classroom. With the measured competition in the work force and jobs becoming more demanding, students need to be more prepared for higher learning and job market with skills. Social skills, problem solving skills, organizational skills and thinking skills should be taught and integrated across school curriculum.

In the book ‘Enhancing Learning and thinking’ Jack Andrews, Robert F, Mulcaby and Robert. H (1991) says that over the past two decades, development occurring in the fields of education and psychology has culminated in substantial intensification of the cognitive education movement. It is very important to gain an understanding of how children actually think in classrooms. Since cognitive development depends upon the interaction between the child and learning situations, the researcher has to find out the problems of matching the child to the most appropriate learning tasks through the Piagetian view of cognitive development of children.

2.3.1 Piaget’s stages of cognitive growth

After examining the thinking patterns that children use from birth through adolescence, Piaget began to find consistent systems within certain broad age ranges. There are four major stages, such as shown in the table 2.1.
Table 1

Table showing the four stages of cognitive growth of a child

<table>
<thead>
<tr>
<th>Age</th>
<th>Stage</th>
</tr>
</thead>
<tbody>
<tr>
<td>0-2</td>
<td>Sensory motor</td>
</tr>
<tr>
<td>2-7</td>
<td>Intuitive or Pre operational</td>
</tr>
<tr>
<td>7-11</td>
<td>Concrete operations</td>
</tr>
<tr>
<td>11-14</td>
<td>Formal operations</td>
</tr>
</tbody>
</table>

Each stage is a system of thinking that is qualitatively different from the proceeding stage. Each stage is a major transformation in thought processes, compared to the preceding stage, a quantum lead forward, a break through. Each child must go through each stage in a regular sequence. Children cannot overcome a developmental lag or speed up their movement from one stage to the next. They need to have sufficient experience in each stage and sufficient time to internalize that experience before they can move on. Our major concern as educators is to understand the major substance of each stage. Only then can the teachers begin to consider 'what to teach and How to teach'. Most recent research has established that it is only for the sensorimotor stage, from birth to two years, that universal agreement exists as to the starting point and the end. Recent researches have shown that:

1. The sequence of stage changes is in the order proposed by Piaget.
2. Cross-cultural studies reconfirm the sequence, though the amount of time within a particular stage may vary.
3. Transition periods between stages are broader and more flexible than predicted and therefore less abrupt.
4. Elements of earlier cognitions and later cognitions are more apparent, though the model characteristics of each particular stage remain as the dominant scheme.

2.3.1.1 Sensorimotor Experience [Zero to two years]

Cognitive activity during the sensorimotor stage is based primarily on immediate experience through the senses. The major intellectual activity of the stage is the interaction of the senses and the environment. Since object permanence develops in this stage, children of this age are capable of some representational thought. They can store information even though their ability to do so may seem quite crude.

2.3.1.2 Intuitive or preoperational thought [two to seven years]

During the preoperational stage, the quality of thinking is transformed. The children are no longer bound to their immediate sensory environment. They started to develop some mental images of the preceding stage and in this stage; they expand that ability rapidly. Their capacity to store images like words and the grammatical structures of language increases dramatically. Vocabulary development, including the ability to understand and use words is especially noteworthy. The average two years old child understands 200 to 300 words while an average five years old child understands 2000 words, a huge percentage increase.

During this stage, a major breakthrough in the use of language is found, since this is the time when children are maximally ready to learn language. Obviously the richer the verbal environment at this time, the more likely it is that language will develop. The major significance of the period is best summed up by Flavell, who notes that while sensorimotor learning is slow, step by step, concrete and tied to immediate experience, pre operational learning is lightening fast and mobile. It is the beginning of symbolic thinking with ideas replacing concrete
experience. The greatest single difference is the level of communication that children can now share their cognition socially.

2.3.1.3 Concrete Operations (Seven to Eleven Years)

Piaget’s next stage represents another major reorganization of ‘mental structure’. In the pre operational stage, children are dreamers with magical thoughts and fantasies in abundance. Now in concrete operation stage, they are young logical positivists who understand functional relationship because they are specific and they can test problems. Their ability to understand the world is now as ‘logical’ as it once was ‘illogical’, that is they can easily distinguish dreams and facts. Schooling in this stage is generally successful when it emphasizes ‘skills and concrete activities’. Boys and girls of this age develop their own way of understanding the subjects in accordance with specific everyday experience. During the prior stage of intuitive reasoning, children exhibit a small amount of ability to reason concretely. Therefore, during concrete stage, children exhibit some fragile ability to reason abstractly, especially when the learning task is simplified. Thus, there is some foreshadowing of the next stage.

2.3.1.4 Formal Operations (Eleven to Sixteen Years)

The shift to the formal operations stage is quite noticeable to the teacher because of the remarkable difference in the characteristics of ‘thinking’. Finding ‘possibilities’ and ‘hypotheses testing’ are the characteristics of this age children. This means that the teenager has a greater potential for examining ‘logical’ evidence before reaching closure. Another important shift is adolescent’s ability to think about their ‘own thinking’ and the thoughts of others. This is known as ‘meta cognition’. This kind of self-reflection allows for a wide-ranging stretch of the imaginations. Opportunity for self-correction in problem solving is much greater. Closely related to meta-cognition is the new awareness that different people have different thoughts about the same idea or situation. They understand that others
have different interests, knowledge and ways of thinking than they have. This characteristic of ‘formal operational thinking’ may have direct connections to the process of ‘reading development’. When the potential for abstract thought is developed, students are able to attain logical, rational and abstract strategies. Symbolic meanings, metaphors and similes can now be understood. Stories with a moral can be generalized. Games and simulations can be presented so that the learners understand their implications. During this stage, writing poems is more effective than reading poems, making films more effective than viewing them, taking part in an improvisational drama more effective than observing it. Probably the most creative and significant task confronting school teachers is the challenge that this theory of growth presents in building new approaches to the development of curriculum materials.

A significant educational implication of cognitive development is that growth in any stage depends on activity. The development of brainpower is not fixed at birth but is a function of appropriate activity during any particular stage. Children must engage in appropriate activities to learn. Hence, ‘Activity produces cognitive growth’.

2.3.2 Bruner’s View on cognitive growth

Bruner expressed that the thinking of a child develops at three stages such as:

1. **Enactive stage**: the events are described through motor activities

2. **Iconic stage**: the events are described through the mental images of perceptual areas.

3. **Symbolic stage**: such forms of characteristics, which represent the distance and decontrol i.e. action, image and word, describe the events.

The child is at first in the level of motor performance, then starts constructing images, at the end learns the use of words, and begins his language learning. All these three phases are closely related to the three periods described by Piaget. In our
modern education, the main difficulty is that our education begins with the word or with the abstract forms of experiences. Our education will be more effective for our small children if it begins with the sensation.

Sensation is the most elementary process, which is essential for cognition. Sense organs, the gateways of knowledge provide sensations. Scientists have differentiated five types of sensations corresponding to five sense organs, such as visual, auditory, olfactory, touching and tasting. Hence the sensations when infused with meaning give perceptions. Concept formation is the next process in cognitive development after perceptions are made.

2.4 INDUCTIVE THINKING MODEL

Hilda Taba (1967) has developed Inductive Thinking Model based on conceptions of mental processes and the ‘theory of building’. The focus of this model is on developing mental abilities and emphasizing concept formation involving cognitive tasks. To quote Hilda Taba, “the subject matter has to be seen as consisting of three levels of knowledge. Each of which served special function in curriculum organization. Thus specific plans are needed for selecting and organizing the learning experiences through which, the students could achieve several different objectives, such as discovering important ideas, mastering relevant skills and developing attitudes, attention and the like to the kind of teaching strategy required by a successful pursuit of these objectives”. Her approach to designing of teaching has a wide range of applicability. Recent studies have shown that thinking can be earned developmentally. Teaching strategy that helps the students to higher level of thinking involves what questions were asked, what the teacher told or sought and at what point to the proceedings. Thus, Hilda Taba’s ideas were fore runners for the later educational reforms of 1980s and 1990s.
2.4.1 The theory of Inductive Thinking Model

The theory of Inductive thinking, that is higher order thinking, stems from Hilda Taba’s belief that the skills used in Inductive thinking need be taught and practiced by students. Her approach has been built around three assumptions:

**Thinking can be taught**

Teaching as used by Taba means ‘helping the students through practice to develop Inductive thinking abilities’.

**Thinking is an active transaction between the individual and data**

This means that the students are presented with sets of data from a particular domain (poems, rocks, countries etc). They organize the data into conceptual systems, relating points in the data in each other, generalizing from relationships they discover and making inferences to hypothesize, predict and explain phenomena. Mental operations cannot be taught directly in the sense of being given by a teacher or be acquired by absorbing someone else’s thought products. The teacher can however assist students by providing ‘tasks’ requiring mental processes, by modeling and by offering progressively less direct support as the children become more proficient.

**Process of thought can be evolved by a sequence that is ‘lawful’**

Taba postulates to master certain thinking skills, a person must first master certain earlier ones and this sequence cannot be reversed. Therefore ‘this’ concept of lawful sequence requires teaching strategies that observe these sequences. (Taba 1966). One can argue this assumption but Taba builds a logical series of strategies by applying it. Students begin by learning how to classify information and form categories. Through this logical progression of steps, students are able to gain the skills needed for Inductive thinking. Taba integrated the teaching of thinking with the study of content, so it becomes easily adaptable to any content area.
2.4.2 Teaching strategies associated with Inductive thinking

Hilda Taba identifies three Inductive thinking skills and describes three strategies to develop them.

- Concept formation (the basic teaching strategy)
- Interpretation of data
- Application of principles

2.4.2.1 Concept formation

This stage involves,

a. Identifying and enumerating the data relevant to a topic or a problem.

b. Grouping these items into categories whose members have common attributes.

c. Developing labels for the categories.

To engage students in all activities, Taba invented teaching moves in the form of tasks given to the students. Each ‘overt’ activity elicited by the teaching strategy reflects mental operations that are hidden from view, which Taba referred to as ‘covert’. The table given below illustrates the relationship between the overt activities in the concept formation model. The mental operations that the students presumably perform during the activity and the eliciting questions. Teachers lead the students through each activity.

**Table 2**
Table showing the strategies for Concept formation

<table>
<thead>
<tr>
<th>S. No.</th>
<th>Overt activity</th>
<th>Covert mental operation</th>
<th>Eliciting questions</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>Enumerating, Listing</td>
<td>Differentiation (identifying Separate items)</td>
<td>i. Where did you see? hear? note?</td>
</tr>
<tr>
<td>2.</td>
<td>Grouping</td>
<td>Identifying common properties, abstracting</td>
<td>ii. What belongs together? On what criteria?</td>
</tr>
<tr>
<td>3.</td>
<td>Labeling, categorizing</td>
<td>Determining the hierarchical order of items (super and subordination)</td>
<td>i. How would you call these groups.</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>ii. What belongs to what?</td>
</tr>
</tbody>
</table>
2.4.2.2 Interpretation of Data

Taba's second teaching strategy is built around the mental operations, which refers to as interpreting, inferring, and generalizations.

Table 3
Table showing strategies for Interpretation of Data

<table>
<thead>
<tr>
<th>S. No.</th>
<th>Overt activity</th>
<th>Covert mental operations</th>
<th>Eliciting questions</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>Identifying critical relationship</td>
<td>Differentiating</td>
<td>i. What did you notice? see? find?</td>
</tr>
<tr>
<td>2.</td>
<td>Exploring relationships</td>
<td>Relating categories to each other, determining cause and effect relationship.</td>
<td>i. Why did this happen?</td>
</tr>
<tr>
<td>3.</td>
<td>Making inferences</td>
<td>Going beyond what is given? Fixing implications Extrapolating.</td>
<td>i. What would you conclude? ii. What does this mean? iii. What picture does it create your mind?</td>
</tr>
</tbody>
</table>

The above table shows the 'overt' and 'covert' activities involved in interpretation of data and the questions. A teacher can use to elicit the activities. Essentially, the students build hypotheses about relationships, inferring causation and explore these hypotheses to build generalizations. In the first phase, the teacher's questions lead students to identify critical aspects of the data. For example after students classify countries as described above, they might read about their economic and political systems and try to identity their salient aspects (such as which ones depend on a few agricultural or mining products, which one depend on economic or manufacturing and which one's combine all of these). Second, the students are to explore relationships. Hence, the teacher asks questions concerning causes and effects. For example, the teacher simply asks, do you think the
difference in economic systems related to differences in per capita income or educational levels?

2.4.2.3 Applications of principles

The third task is that of applying principles to explain new phenomena (predicting which countries have similar interest that might affect how they would vote on relevant issues in the United Nations assembly). This strategy follows the first two, a unit or course would lead the students from concept formation activities to activities requiring interpretation of data and then to activities requiring application of principles. At each stage, students would be required to expand their capacities to handle information. At first for developing new concepts and then for developing new ways of applying established principles in new situations. The following table describes the ‘overt’ activities, ‘covert’ mental operations, and the eliciting questions for this teaching strategy.

<table>
<thead>
<tr>
<th>S. No.</th>
<th>Overt activity</th>
<th>Covert mental operations</th>
<th>Eliciting questions</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>Predicting consequences explaining un familiar phenomena hypothesizing</td>
<td>Analyzing the nature of the problems or situation, retrieving relevant knowledge</td>
<td>What would happen? If...?</td>
</tr>
<tr>
<td>2.</td>
<td>Explaining or/ and supporting the prediction and hypothesis</td>
<td>Determining the casual links leading to prediction or hypothesis</td>
<td>Why do you think this would happen?</td>
</tr>
<tr>
<td>3.</td>
<td>Verifying the predictions</td>
<td>using logical principles or factual knowledge to determine necessary and sufficient conditions</td>
<td>What would it take this to be generally true or probably true?</td>
</tr>
</tbody>
</table>

Table 4
Table showing the strategies for Application of Principles
The first phase of strategy requires students to predict consequence, explain unfamiliar data or hypothesize. By asking the students to predict how the numbers of people sharing various cultures are likely to altered, when population growth data are considered. In the second phase, students attempt to explain or support the prediction or hypotheses. For example if someone feels that a fixed currency rate for all countries should be established and held for a long time that person would attempt to explain why he or she thought this system would work and how it would fare with such factors as the relative prosperities or production ratios within the countries. In the third phase, students verify these predictions or identify conditions that would verify the predictions.

2.5 ELEMENTS OF INDUCTIVE THINKING MODEL

Inductive Thinking Model consists of four elements such as syntax, social system, principles of reaction, and support system. The details are as given below:

2.5.1 Syntax

Hilda Taba’s teaching strategies strongly resemble each other. Each is build around a mental operation. Students must go through certain covert operations to perform the activities. Of activities forms the syntax of the teaching strategies and presumably accompanied by underlying mental processes. In each case the teacher moves the strategy along by means of eliciting questions to guide the student from one phase of activity into the next at the appropriate time. In the case of concept formation strategy, for example, the grouping of data would be premature, if the data have not been identified and enumerated. But to delay too long before moving to the next phase would be to lose opportunities and interest. To teach students to respond to the model, teachers have to begin by leading the students through activities based on data sets presented to them.
2.5.2 Social system

In all three strategies, the classroom atmosphere is cooperative with a good deal of students' activities. The teacher is generally the initiator of phases and the sequence of the activities is determined in advance. Though the teacher acts as a controller, the students assume greater control while they learn the strategies.

2.5.3 Principles of reaction

Hilda Taba provides the teacher, a clear guidelines for reacting and responding within each phase. When using cognitive tasks, within each strategy, the teacher must be sure that the cognitive tasks occur in 'optimum order' and also at the 'right time'. Regulating the task requires that studying the data set is done thoroughly before categorization proceeds and that seeking for relationships follows through categorization. The teachers primary mental task in the course of the strategies is to monitor how students are processing information and then to use appropriate eliciting questions. The important task for the teacher is to sense the students' readiness for new experience and new cognitive activity with which to associate and use those experiences.

2.5.4 Support system

These strategies can be used in any curriculum area that has large amount of raw data that need to be organized. For example in studying the economic aspects of various nations, students would need large quantities of data about the economics of those countries and statistics about world affairs. Then the teacher's job is to help them process the data in increasingly complex ways and at the same time to increase the general capacities of their systems for processing data.

2.5.5 Instructional and nurturing effects of Inductive Thinking Model

The Inductive Thinking Model is designed to instruct students in concept formation and simultaneously to teach concepts. It nurtures attention to logic attention to language, to meaning the words and to the nature of knowledge.
2.5.6 Application of Inductive Thinking Model in schools

Each of Taba’s teaching strategy is built on a particular mental task. Hence, the primary aim of this model is to develop ‘thinking capacity’. However, in the course of developing thinking capacity, the strategies obviously require students to ingest and process large quantities of information. The model can be used for every curriculum area and from kindergarten through high school. The third strategy by inducing students to go beyond the given data is a deliberate attempt to increase productive or creative thinking. Inductive processes thus include the creative processing of information as well as convergent use of information to solve problems.

The concepts formation strategy can be used with students of all ages from nursery school through graduate study. This model causes students to collect
information and examine it closely to organize it into concepts and to learn to manipulate these concepts. Used regularly, the strategy increases the students' abilities to form concepts efficiently and also the perspectives from which can view information. For example, if a group of students regularly engage in an inductive activity, the group can get more and more sources of data. The students can learn to examine data from many sides and to scrutinize all aspects of objects and events. If a classroom of students works in groups share the categories they develop, they will stimulate each other to look at the information from different perspectives. The students can learn to categories, too, and build concepts that further cluster those categories.

This model is adaptable to a wide range of learning styles. Joyce, Peck and Brown (1981) explored Inductive processes with both relatively rabid and flexible students and found that they were able to engage in the inductive process but more flexible students made the greatest gains initially. They found that practice and training increased effectiveness and that the students could learn to carry on inductive activity independently. Thus Taba introduced the Inductive teaching strategies essential tools.

The investigator, after reviewing Taba's Inductive Thinking Model, has determined the following principles for her research:

1. The goal of this model of teaching is to help students construct a deep and thorough understanding of specific topics.
2. To involve students actively in the process of constructing that understanding.
3. To help students gain skill and confidence in sensing their own environment.
4. In the method of instruction, teachers should use powerful examples to help students learn a concept, principle, generalization or academic rule.
5. When presenting examples, teachers should guide students, thinking through a series of open-ended questions, so that students can be induced to think on the concept, principle and generalization.

6. The teacher should teach higher order thinking skills in a motivating way and to help the disabled students to learn geography concepts. Based on above principles, lesson plans, are prepared on this model of instruction to Standard VII students.

2.6. CONCEPT FORMATION

Concept formation is a process of developing abstract rules or mental constructs based on sensory experience. Concept Formation figures prominently in cognitive development and was a subject of great importance to Jean Piaget, who argued that learning entails an understanding of a phenomenon characteristics and how they logically linked. Noam Chomsky later argued that certain cognitive structures such as basic grammatical rules are innate in human beings. Psychologists use the term 'concept formation' or 'concept learning' to refer the development of the ability to respond to common feature of categories of objects and events or ideas that have a common set of features. Concepts allow us to classify objects and events. In learning a concept, one must focus on the relevant features and ignore those that are irrelevant.

Most of the words are used to concepts and not to particular things. Proper nouns such as 'william James' and 'california' are exceptions. In learning some of their first concepts, children commonly focus not on names but on the functions of objects. For example, a spoon is something to eat with and a pan is something to cook in other early concepts are based on grouping of subjects that are similar in some respect for example liquid things, moving things or soft things. Several theories have been proposed to explain how we learn concepts. The 'stimulus response association' theory was proposed by Clark Hall in 1920. He argued that
we learn to associate a particular response i.e. the concept with a variety of stimuli that define the concept. For instance, one associate the concept ‘dog’ with all of the characteristics of dog i.e four legs, fur, tail and so on and are able to generalize the concept to unfamiliar dogs.

**Eleanor Rosch (1978)** suggested that the natural concepts in everyday life are learned through examples rather than abstract rules. Her theory proposes that we learn the concept of ‘dog’ by seeing a wide variety of dogs and developing a prototype of what the typical dog is like. **Busemayer and Myung (1988)** studied prototype learning in college students by presenting a sets of examples and asking the subjects to reproduce the prototype. This type of study allows researchers to gain an understanding of the concept learning process. Over the years, everyone is faced with an infinite number of complex stimuli. How we choose to group and sort than into concepts will depend upon our interests, beliefs, values, and experiences with the environment consider the concept ‘job’. To one person if may mean an unpleasant task, while to another it is a means of achieving fulfillment. Concept formation is a form of thinking that helps us to understand the world we live in as well as ourselves.

The objectivist theory explained the first step in concept formation, called ‘differentiation’ is to isolate two or more things as belonging together, as ‘units’ of the same class. Where many theories of concept formation hold that such isolation begins by noticing degree of similarity objectivism holds that it starts by noticing degrees of differences. At the perceptual level everything is different, however, something are more different from others. The difference between two tables, for instance, is less than the difference between a table and a chair. Because two tables are less different from one another when contrasted against a third object, we group them together as ‘Units’ as members of a group of similar objects. The ‘second step’ of concept formation, ‘integration’ is based on a process called ‘measure omission’. For example, when forming the concept ‘table’ we retain the
distinguishing characteristics a flat, level surface and supports but omits the particular measurements of those features. Based on the two-step process, concepts are defined as ‘a mental integration of two or more units possessing the same distinguishing characteristics, with there particular measurement omitted’.

2.6.1 PRINCIPLES PERTAINING TO CONCEPT FORMATION

Klausnæir in his book ‘Learning and Human abilities’ in 1971 outlines certain principles pertaining to concept formation and in keeping with them offers instructional guides. The principles are given below:

1. Attending to likeness and differences among things, qualities and events are essential to subsequent classification.

2. Acquiring the names of concepts, attributes and instances facilitates the initial learning of concepts.

3. Cognizing the definitional basis and the structure of concepts to be learned facilitates concept learning.

4. Cognizing the attributes or other properties and the rules that define the concept is facilitated through encounters with positive and negative instances of the concept.

5. Inferring a concept inductively or deductively requires cognizing the defining attributes and rules, remembering information and evaluating information.

6. Cognizing the instances of the concept; cognizing other concepts as co-ordinate, subordinate, and super ordinate and using the concepts informing principles and in solving problems extend the individual concept.

7. Evaluating one’s concept is essential for independence in concept learning.

2.6.2 Concept formation as a teaching strategy

The purpose of concept formation as a teaching strategy is to have the students examine carefully some object and to think about a method for classifying
the objects. Both observation and classification are important in science. Indeed, the more carefully the students observe the more interesting questions they would come up. In addition, as discussed for concept attainment activists, the ways in which scientists classify are unique and often very different from the way in which we classify in our daily lives. The science classification methods are not superior to everyday classification. However, the students should learn how it is that scientists classify, so that they can have a better idea of what two scientists are talking about or can read a newspaper or science article intelligently.

Concept formation as teaching strategy encourages certain aspects of the common essential learning. The most obvious are 'critical and creative thinking'. Communication and of course independent learning, personal and social values and skills might be included if the teacher helps the students work in a positive way with their peers. As well, if the particular concept involves mathematical relationships, the students could use their numeric. If the particular concept involves understanding a technology, technological literacy would be addressed. Of course, as the students classify in the ways that scientists do, they would be learning a technique of science and understanding techniques could be part of technological literacy.

**Practicalities - Set up**

- Give the students a number of materials. These might be written, they might be thoughts. Tell them to think of different animals for example or they might be real things. It is preferable to have the students work with real things.
- Tell the students to classify the materials in a way that makes sense. If the teacher would like the students to focus on a particular aspect of the materials and tell them to focus on this aspect.
- The teacher might or might not have activities for the students to do with the materials so the students would study them in different ways. If the teacher
wants them to focus on the results of the activities for forming their concepts, then the teacher would ask them on these results.

- The teacher would probably put the students into small groups. Therefore, the group would work effectively together.
- If the teacher wishes to minimize the supervisory role, he should choose the materials that are relatively safe to work with.

**Carry out**

- The students study the materials and organize them to some sort of rationale. They make their rationale explicit to their peers. Their rationale could be considered hypotheses for why some materials belong together and others do not.
- The teacher’s role at this stage is to meander through the classroom, observing the students at work. The teacher would act as ‘referee’ and ‘coach’. If students are hesitant about taking initiative or if they are not testing the materials in a way in which they would, he must encourage them to go on with more tests.
- During this time, the teacher could make anecdotal records or fill in a checklist of student actions.

**Debrief**

There are number of ways in which debrief can be done. In all large groups, the teacher should encourage the students to use conversation skills. Their conversational skills are to listen carefully to what other speakers say. Then when they talk, they build on what others have said and demonstrate this by using phrases such as ‘what I think is similar to what said’ or I disagree with what said, because:

- Encourage them to speak tentatively with phrases such as I thought or it seems.
- Having each group of students explain their rationale for the classification.
• Drawing attention to the different ways in which students classify, if this is the purpose of the activity.

• Drawing attention to the diverse observations. Different groups would have observed different aspects of same objects.

• If the teacher expected his students to form a particular concept and they have not, think of why they would not have, what background knowledge were they lacking or what background knowledge contributed in a non-science way? What other materials might have helped them to form the concept, which the teacher wanted to form.

**Final check**

Once the students have organized their materials, the teacher should give them one or more extras and ask them to fit in with the groups they have. This is a way for them to test their hypothetical categories. If they can fit the new materials into the concepts they already have, then they should be content with the concepts they formed.

During the debrief, the teacher would learn the students’ conceptions and determine in what ways the teacher can improve their learning or improve their moving towards the conceptions accepted by science. During the debrief, the teacher would decide what extra tests the students should carry out or what extra materials to apply for the last stage, the final check. In geography teaching, an example for concept formation model can be carried out. The student can build play dough scale models of the planets and to research and write descriptions of each planet. They are to classify the planets considering at least two different factors must put the planets into the same group. For example if the students were able to use the factors of size and distance from the sun, there would be three or groups the four small and close planets, the Pluto in a category of its own. Social studies concepts are abstract ideas or words. Such abstraction might relate to place, events and the items we use.
To understand concepts, learners need to make mental images. To develop concepts one can use instructional strategies such as:

- Defining abstract words
- Series of activities
- Examples from non examples
- Listing, grouping and label things
- Problem solving
- Decision making
- Concept mapping

Thus the most important issues in cognitive psychology is the development of concepts or concept formation. It provides students with an opportunity to explore ideas by making connections and seeing relationships between items of information. This method can help students to develop and refine their ability to recall and discriminate among key ideas, to see commonalities and identify relationships, to formulate concepts and generalizations, to explain how they have organized data and to present evidence to support their organizations of the data involved. Concept formation lessons can be highly motivational because students are provided with an opportunity to participate actively in their own learning. In addition, the thinking process involved helps them to create new and expanded meaning of the world around them as they organize and manipulate the information from other lessons and contexts in new ways.

2.7 LOGICAL REASONING

Logical Reasoning is the strength to reason in a factual logical way. James Barrett and Geoffrey Williams (1980) say that it is often combined with strength to indicate the way of thinking. It reflects the ability to ‘think quickly’ to solve problem.
2.7.1 Logic

'Logic' is primarily concerned with distinguishing correct reasoning from reasoning that is incorrect. It is the study of prescriptive systems of reasoning that is systems proposed as a guide for how people (other intelligent beings/machines/systems) ought to reason. Logic says which forms of references are valid and which are not. Traditionally, logic is studied as a branch of philosophy, but it can also be considered a branch of mathematics and computer science. How people actually reason to usually study under other headings including cognitive psychology. Logic traditionally divided into Deductive reasoning and Inductive reasoning. Deductive reasoning is concerned with what follows logically from given premises and Inductive reasoning is concerned with how one can go from some number of observed events for a reliable generalization.

2.7.2 Reasoning

Reasoning is the act of using a reason to derive a conclusion from certain premises. In general a distinction is made between reasoning from the general of the particular (deductive reasoning) and reasoning from a particular to the general (Inductive reasoning). Both types of reasoning are of interest to such disciplines as philosophy, psychology and Artificial Intelligence. Induction and deduction are key elements in human's intellectual life as they are ubiquitous in human reasoning. The rules of deduction have been specialized by logicians. These rules tell rather precisely, which deductive conclusions are valid, that is warranted by the available information and which are invalid. One's Inductive inferences are only valid if they are made in accordance with these principles. One can think of 'logic' as specifying the 'correct' way to reason deductively – the pattern of deduction endorsed by the relevant scholars. 'Logic' thus provides a 'normative' account of deduction as opposed to a descriptive account. Normative accounts tell how things ought to go; descriptive account tells merely how things are in the same way. Statistics and
scientific methodology provide normative rules for inductive reasoning, telling how this form of Inductive thinking ought to proceed.

2.7.3 Logical reasoning

If the people, reasoning about the problems by using logic, then it is called logical reasoning. For a logical reasoning, rationale is to be provided. For example, to examine the case of thermal insulation, the following questions can be asked before and after the students had received instruction (Tiberghien et al., 1984). For example, if you wanted to carry some ice from one place to another, what kind of container would you put them in? You have 1) Metal cup, 2) Ordinary drinking glass, 3) Plastic coated paper cup, 4) Drinking glass wrapped in cloth. Thus logical reasoning and learning are closely related, because both are the methods of solving problems and learning usually resulting from the process of reasoning.

2.7.4 Hallford's structure mapping theory of Logical development

Hallford says, 'Transitive inference depends on making analogical mappings. Limitation on processing capacity prevents child from using complex mappings. Later on such abilities emerge when sufficient processing capacity has developed'. This concludes that when a person is solving a problem, he can use a strategy called 'logical reasoning'. Logical thinking exercises help the children learn the process of elimination or deductive thinking. Most problems give a variety of conditions and one must use an 'if ... then' approach. It is important that he must read the whole problem and choose the best hint or clue before starting to solve the problem. When practicing logic with reasoning, making a chart or drawing picture are good strategies.

2.8 STYLES OF THINKING

Humankind has been thinking about thinking since the time of the ancient Greeks. Since 1995, the developers of 'thinking styles' have noticed an increase in number of consultancies and training organizations specializing in elements of
thinking. This means that there is a renewed interest of thinking. The original concept for ‘Thinking styles psychometric’ was developed by Fiona Beddoes Jones (1995) as a means of adding value to personal and professional development programmers. ‘Thinking styles’ measures people’s cognitive and linguistic preferences and levels of flexibility at work for twenty six types of thinking (dimensions). It does not measure the ‘thinking ability’ nor is it a measure of ‘intelligence’.

Robert J. Sternbergg (1999) says, ‘In our society, the recognition of talent depends largely an idealized and entrenched perceptions of academic achievement and job performance. Thinking styles bucks this trend by emphasizing the method of our thought rather than its content’. He further argues that the ability often goes unappreciated and uncultivated not because of lack of talent but because of conflicting ‘styles thinking and learning’. Using a variety of examples that range from scientific to personal anecdotes, Sternbergg presents a theory of ‘thinking styles’ that aims to explain why aptitude tests, school grades and classroom performance often fail to identify real ability. He believes that criteria for intelligence in both school and workplace are unfortunately based on the ability to confirm rather than to learn. He takes the theory a step further, by stating that ‘achievement’ can be a result of the compatibility of personal and institutional thinking styles and ‘failure’ is too often the result of a conflict of thinking styles rather than a lack of intelligent or aptitude. Sternbergg bases his theory on hard scientific data yet presents a work that remains highly accessible. The following are brief excerpts from the book ‘Thinking styles’ by Robert’s. Sternberg (1977).

2.8.1 Principles of ‘Thinking styles’

1. Styles are preferences in the use of abilities, not abilities themselves.

2. A match between styles and abilities creates synergy that is more than the sum of its parts.
3. Life choices need to fit styles as well as abilities.
4. People have profiles (or patterns) of styles, not just a single style.
5. Styles are variable across tasks and situations.
6. People differ in the strength of their preferences.
7. People differ in their stylistic flexibility.
8. Styles are socialized
10. Styles are measurable
11. Styles are teachable
12. Styles valued at one time may not be valued at another.
13. Styles valued in one place may not be value in another
14. Styles, an average, are not good or bad. It is a question of fit.
15. We confuse stylistic fit with levels of at ability.

2.8.2 Functions of Thinking Style

Based on functions, J. Sternberg classifies the Thinking styles into three types such as:

2.8.2.1 Legislative style

Legislative people like to do things in their own way. They like creating, formulating and having things. In general, they tend to be people whom like prefer creative and constructive planning based activities such as writing papers, design projects and creating new educational system.

2.8.2.2 Executive style

People with execution style are implementers. They like to prefer to be giving guidance as to what to do or how to do and what needs to be done. They like to enforce rules and laws of their own or others. Executive people prefer problems that
are given to them or structured for them and like to do and take pride in the doers, in getting things done.

2.8.2.3 Judicial style

People with judicial style like to evaluate rules and procedures and to judge things. Judicial people also prefer problems in which they can analyze and evaluate things and ideas. They like to judge both structure and content. Legislative and judicial people can work in a team will together.

2.8.3 Theory of Brain Hemispherity

Researches conducted during the last two have shown that the human left cerebral hemisphere is to be specialized for primarily verbal, analytical, abstract, temporal and digital operation Grinstein (1972). The same investigations revealed that the right hemisphere is to be specialized for primarily non-verbal holistic, concrete, creative, analogical and aesthetic functions. Zelinski and Marsh (1976) For identifying the hemisphere dominance, the way in which and the levels at which the information is being processed by the individual are to be studied in this research. Experimentation has shown that the two different sides or hemisphere of the brain are responsible for different manners of thinking. They are shown in the table given below:
Table 5
Table showing the brain hemispherity

<table>
<thead>
<tr>
<th>Left Brain hemispherity</th>
<th>Right Brain hemispherity</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Logical</td>
<td>1. Random</td>
</tr>
<tr>
<td>2. Sequential</td>
<td>2. Intuitive</td>
</tr>
<tr>
<td>3. Rational</td>
<td>3. Holistic</td>
</tr>
<tr>
<td>5. Objective</td>
<td>5. Subjective</td>
</tr>
</tbody>
</table>

Allen F. Harrison and Robert M. Bramson have conducted research on ‘Thinking styles’ in 1997. They concluded from their research that all thinking could be subdivided into five categories. They have coined the terms for the five thinking styles:

- Synthesists
- Idealists
- Pragmatists
- Analysts
- Realists

Most people show a marked preference for one or two of the styles. Approximately 35% of the people show equal preference for two styles, while the majority of people show a preference for a single style of thinking. In general, schools tend to favour, left-brain modes of thinking while down playing the right brain ones. Left-brain scholastic subjects focus on logical thinking, analysis and accuracy right brain subjects on the other hand, focus on aesthetic, feelings and creativity. Bernic Mc Carthy has experimented how right brain and left-brain
thinking impacts learning. In order to be more ‘whole-brained’ in their orientation, schools need to size equal weightings to arts, creativity and the skills of imagination and synthesis in school curriculum. Thinking style is at the forefront of research in the area of generative Neuro-Linguistic Programming (NLP), which explains the ways in which people perceive and understand the world around them and how they, then translate that perception of the external world into an internal representation within their own minds. Richard Bandler’s work is recognized as some of the first building blocks of Neuro-linguistic Programming (NLP).

2.9 AWARENESS TO NATURE OF KNOWLEDGE

Awareness to Nature of knowledge is another nurturing effect of Inductive Thinking Model. Hilda Taba has developed this model based on the conceptions of mental processes and theory of building. The focus of this model is on developing mental abilities and emphasizing concept information involving cognitive tasks. To quote Hilda Taba ‘The subject matter has to be seen as consisting of three levels of knowledge’. Each of which served special functions in curriculum organization. Specific plans are needed for selecting and organizing the learning experiences through which the students could achieve several different objectives such as discovering important ideas, mastering relevant skills and developing attitudes attention and the like, to the kind of teaching strategy required by a successful pursuit of these objectives.

2.9.1 Meaning of Knowledge

Knowledge, being the understanding of truth, life and living, is housed in minds, brains, nervous systems, and such, yet the pattern of knowledge is a sub microscopic package of energy. Animals have intimate knowledge about their own ecosystems but not more. A well-educated person may conclude that the ability for the human to obtain knowledge is due to man’s superior brain. However, knowledge is sufficient to efficient and contented living. Knowledge is omnipresent
and omniscient and each creature has a hierarchy of knowledge. Knowledge is a primary fact of human life and experience. Everyone understands what it means ‘to know.’ The concept of ‘knowledge’ eludes every effort at an exact definition because it is a primary fact of experience. One can point out certain characteristics of it and adduce definite instances of knowledge but cannot really define it easily.

**There are three elements, which enter into knowledge:**

- The knowing subject
- The known object and
- The mental act of knowing, which is called ‘cognition’

The subject is obviously the one who knows. The object of knowledge is everything and anything that is known by man. The subject knows the object by an act of knowing. This takes place in the subject or knows and is a unities act in as much as it brings the object and the subject into contact with each other. Truth and Error enter into our knowledge, when this knowledge is expressed in Judgments.

2.9.2 Definition of ‘Knowledge’

“Knowledge is the awareness and understanding of facts, truths, or information’s gained in the form of experience or learning or thought introspection. Knowledge is an appreciation of the possession of interconnected details which in isolation, are of lesser value”.

Knowledge is the act or condition of knowing something with a familiarity gained through experience or association. It means ‘to perceive directly’ ‘to have direct cognition’, ‘to apprehend intellectually’ and ‘to acquire facts’ - Jonathan Dolhenty.

‘Knowledge is built up from interaction with the world, and is organized and stored in each individual’s mind. It is also stored or an organizational level within the minds of employees and in paper and electronic records. Two forms of
knowledge can be distinguished. Tacit or implicit knowledge which is held in a person’s mind and is instinctively known without being formulated into words and explicit knowledge, which has been communicated to others and is held in written documents and procedures.

"Knowledge can be considered as the distillation of information that has been collected, classified, organized, integrated, abstracted and value added. Knowledge is at a level of abstraction higher than the data, and information on which it is based and can be used to deduce new information and new knowledge. When considering knowledge, it is usually in the context of human experience used in solving problem. The chamber’s Twentieth century dictionary defines knowledge in many terms such as “an assured belief, that which is known; information; enlightenment; learning; practical skill; acquaintance and cognizance”.

2.9.3 Nature of knowledge

Knowledge is something that evolves in people’s mind by a combination of data, information and experiences. There are two general categories of knowledge, which have to be differentiated. “Tacit (implicit) knowledge and explicit knowledge” (Nonaka and Takenchi 1995). ‘Tacit knowledge’ is the internal knowledge which is hard to describe, (like an example how to side a bike, every one can do it but hardly describe it), while ‘Explicit knowledge’ is codified knowledge, that is knowledge written down, (like an example a hand book).

Knowledge is generated only in people’s minds (Nonaka and Takenchi 1995) and it is very complex. It has to be, because human actions depend on a large number of parameters. The complexity enables the adoption to different kind of situations. Similarly, to a procedure in a programming language, which can solve a certain number of problems by using parameters to define a concrete problem, knowledge provides different reactions depending on the situation. In contrast to code, the parameters of knowledge are unfortunately, hardly countable and
definable. This makes it difficult to record or document knowledge in such a way, those others can benefit from it. It is difficult but possible, however to turn ‘tacit knowledge’ into ‘explicit knowledge’. This kind of knowledge can be stored and transferred and be later turned into ‘implicit knowledge’ by the receivers. However, such explicit knowledge never describes the original ‘tacit knowledge’ as a whole, but instead assumes a common basis of understanding on which the transmission back to implicit knowledge’ is based, because human minds can be assumed to have knowledge about many things. Another Problem is how to locate knowledge? That is to find out who has knowledge about what. This is not always a problem when dealing with small number of people but crossing for border somewhere between 200 and 300 people; it becomes impossible for every one to know who knows what. (Davenport and prank 1998). In addition, ‘organizational knowledge’ held by a group of individuals requires that a number of storage places be taken into account instead of only one specifically (Brown and Dugid 1998).

A distributed environment, as it becomes more and more common with organizations acting, globally, makes this even more difficult. Therefore, besides storage, a major problem is how to make knowledge locatable? Which is a precondition for an effective and efficient use?. However, even if knowledge is stored and can be located, the problem of determining who needs?, what knowledge?, and when?, stays. So it becomes important to interface ‘Knowledge Management’ processes with other organizational processes. This has to be done in such a way that it allows the identification of needs for knowledge and accurate determination of these needs based on which the stored knowledge can be then accessed. Modern technology offers a new and extended possibilities such as codification to video-animations, transmissions and communications via video conferences etc. The use of technology plays a crucial role in ‘Knowledge Management’. However, knowledge is mainly about humans and therefore the role of technology can only be of assisting nature (Davenport 1998).
2.9.4 **Nature of knowledge - Inductive Thinking - ‘Bloom’s Taxonomy’:**

Considering the literature on the meaning, definition and nature of knowledge the investigator has tried to find the effects of Inductive Thinking Model on the nurturing effect of awareness to ‘Nature of Knowledge’ among Standard VII students. Further, she has related Bloom’s Taxonomy with Nature of Knowledge for her investigation. Both implicit and explicit nature of knowledge may be evolved among the students through the ‘Overt’ and ‘Covert’ activities involved in all nine phases of the Inductive Thinking Model, which comprised in three teaching strategies. As knowledge evolves by the combination of data, information and experiences, the students are given more opportunities to involve all activities individually. The concept formation stage involves:

1. Identifying and enumerating the data, relevant to the topic.
2. Grouping these items into categories, where members have common attributes.
3. Developing labels for the categories.

To engage students to each of these activities, Taba invented that, teaching moves in the form of tasks given to the students. Each overt activity elicited by the ‘teaching strategy’ reflects mental operations which are hidden in view as covert. The second strategy ‘Interpretation of data’ is built around the mental operations as interpreting, inferring and generalizing. The overt and covert activities involved in the interpretation of data and the questions, a teacher can use to elicit the activities, lead the statement to build hypotheses about relationship, infer cause and effect and explore these hypotheses to build generalization. The third task of applying principles to explain new phenomenon procure knowledge explicitly. Students would be required to expand their capacities to handle information to develop new concepts and new ways of applying established principles in new situations.

This model provides to teacher a clear guidelines for reacting and responding within each phase. When using cognitive tasks within each strategy, the teacher
must be sure that, the cognitive tasks occur in optimum order, and at right time. The teacher’s primary mental task is to monitor how students are processing information and then to use appropriate eliciting questions. Teacher has to sense ‘student’s readiness’ for new experience and new cognitive activity with which to assimilate and to use that experience.

Inductive Thinking Model calls the students, for concept formation, interpretation of data and application of principles in a sequential manner. The natural growth of knowledge is stimulated the role of teachers to arrange the most appropriate learning environment in order to the nurture that growth. Although Bloom and his associates did not directly connect their objectives, with the Inductive Thinking Model and Piagetian cognitive stages, there exists an implicit relationship lies between them. Bloom’s levels one, two and three, ‘Basic knowledge’ ‘comprehension’ and ‘application’ are all already within the group of elementary age concrete thinkers. The levels four, five and six are moving toward the need for ‘symbolic’ and ‘logical thinking’ in Piaget’s formal operational sense. The descriptions of the style of thinking required at these levels read to realize the importance of a careful instructional sequence to promote the growth of ‘abstract thinking’. One cannot assume that adolescents are automatically able to use formal operations at Blooms levels four to six without teaching that is aimed at objective.

It is inferred that through the teaching of this Model, the awareness to the nature of knowledge among the upper primary students may be developed by allowing the teachers to structure questions that would enable students to use both Inductive and Deductive thinking and encouraging to process the information. Hence, the researcher finds that there is an integration between nature of knowledge and Blooms taxonomy.
2.9.5 Assessment of Nature of Knowledge

The investigator has tried to find out the degree of awareness and ‘Nature of Knowledge’ among the students through an assessment technique. The assessment would be done through the test to identify the students’ ability to recall the facts and to identify the information provided. Restating the material in their own words, re order or extrapolate ideas, predict and estimate on the basis of their capacity to act upon or process information, form a significant part of the assessment. The ability to apply their knowledge to real situations is also assured though critical because it means putting knowledge into action, rather than merely talking about what might be done. The ability to analyze material leads to ‘critical thinking’ which allows the children to analyze or separate ‘fact from opinion’. Piaget’s stage of formal operations involve just this kind of ‘logical thinking’. The students ability to make something new, bringing ideas together to form a new theory, going beyond what is now known, providing new insights, are assessed by writing an original short story, play or poem or painting a picture. The learning of value judgments involves all the previous knowledge to some degree. Through the teaching by Inductive model students may develop the ability to create standard of judgments, to weight, to examine, to analyze and to avoid hasty judgments, students need comprehensive, logical framework as a basis for judgments. In writing such an essay, they provide a sequence of reasons extensively spelled out so that the reader can follow a train of thoughts from each step of the learning to the conclusion.

2.10 Sensitivity to Language

The dictionary meaning of ‘sensitivity’ is ‘response to stimulation of the sense’ heightened awareness of oneself and others within the context of personal and social relationships, and ‘reading and delicacy in recording change’. The dictionary meaning of language is ‘any manner of expressing thought or facing an
artificial system of sign and symbols with rules for forming intelligible communications for use’.

The consolidation of signs and symbols to convey the thoughts of an individual to other person is language. Therefore, the ‘sensitivity to language’ is considered to be ‘the response to the language’. Language includes skills of reading, writing, listening and speaking. J. Sternbergg (1986) says ‘A language system has linguistic symbols (letters), sounds (spoken words) and grammatical rules (syntax) which operate together to form a very complex form of communication’. Language is not an instinct but a skill. Factors of learning are important in learning of language. Children perceive the concepts through the mechanism of language. Eventhough, more than 3000 languages with different vocabularies exist in the world, the members of the group quickly learn language of any group, without considering its simplicity or complexity. It is because of that one can say, ‘ability in language is universal’. Therefore, any normal children learn to speak language.

Language can be studied on a number of levels, which may be broadly classified as ‘lexical’ (concerning the word units themselves and their reference) ‘syntactic’ (concerning rules for combing words into meaningful differences) and ‘semantic’ (concerning the meaning of what is said). Peter Stratton and Nicky Hayes in their book ‘students’ dictionary of psychology’ say that the use of analogy and metaphor in language means that the lexical characteristics of an utterance may not identical with its semantic characteristics. (e.g. describing someone as ‘burning’ with enthusiasm). Psychologists have also studied social aspects of language use; such as the impact of accents and recently much research attention has been devoted to ‘discourse analysis’ looking at the way that language is used to complete conversation.
2.10.1 Thinking and language

Language is a tool for thinking. Thoughts cannot be expressed without language, nor communications are possible among human beings. The function of language in thought process cannot be examined without any references to signs. Signs represent the objects and events of the world. ‘Linguistics’ and ‘non linguistics’ are two kinds of signs. In language a set of letters and sounds are combined in some particular fashion to represent the objects, events and our experiences. When a man sees an object he points it out, when he witnesses an event he explains it and when he had some kind of experiences, he expresses it. The interconnections between language and thought is studied in ‘linguistics’, when the new field ‘psycholinguistics’ analyze language into its basic components i.e. psychology and language. Psycholinguists use linguistic principles to understand the ways in which people use, generate and comprehend language.

2.10.2 Structure of language and language development

The meaning of word and its various associations among them and various possible occurrences constitute the ‘structure of language’. Rajamanickam says, ‘how extensively a language is used, depends upon the structure of language’.

There are two kinds of meaning : 1. Extensional 2.Intentional. The answer to the question, what is a cat? can be given by pointing out a cat which has ‘extensional meaning’. While the cat is pointed out by combining the cat with words, the meaning expressed by verbal description of words is called ‘intentional meaning’. The intentional meaning of a word may vary from person to person.

It is found that one’s adjustment to his total environment is positively correlated with the extent of his vocabulary. If he has a knowledge of quite a good number of words, he can comprehend his environment better and can manipulate it for his own advantage. Studies have shown that vocabulary influences a man’s position. The clear words with unambiguous meanings create better understanding.
This language development depends upon motivation, conditioning and imitation. It is necessary that the teacher should keep in mind, the teaching factors of individual needs, meaningful repetition, a good example in his teaching of language, the rich and varied experience to the child would increase his ‘language readiness’.

### 2.10.3 The development of meaning

Perceptions require proper attachment of meaning to sensation. Meaning is given to each experience. The meaning given is usually in the form of ‘verbal symbol’. For this, language is the chief vehicle. To symbolize experiences or meanings ‘words’ are used. Words are also ‘means of expressing relationship in experience’. They are organized in sentences. These sentences convey the meanings of words in relation to one another. With the help of words, one can classify the experiences and label them in terms of their common characteristics. On account of these, the concern on the development of meanings or ideas in the course of learning process and in understanding of the meanings of spoken and written language, is increasing. Hence, the teacher should:

1. Use simplified vocabulary. It is essential to develop technical terms systematically and to review or use them meaningfully in a variety of purposeful activities.

2. Enrich the individual experience and provide purposeful opportunities for him to use and to interpret language, relevant to his experimental background. This is fundamental in stimulating comprehension. To enrich the experiences,

   i. The children should be made conversant with the local environment.

   ii. The teacher should use various teaching aids made of local resources.

   iii. Projects are to be organized to achieve clear-cut educational objectives. In the final analysis, when complete meaning is
incorporated into a word or derived from it, the individual has an idea about it, a concept of it or a generalization about it.

2.10.4 Learning to read/learn

For learning to read, it is essential that the child can talk in a comprehensive manner and can understand what others are saying. This stage is reached when the child is about five or six years old and it continues till the age of ten or fifteen years. After this age, the child develops an ability to do ‘self reading’.

A large number of words are learnt while reading. They are learnt by deriving meaning from the context of a sentence or paragraph based on the meaning, contained in the words around it. The meanings of the new words can be figured out. Awareness of the skill underlying ‘knowledge acquisition’ will improve the ability to absorb what is read, and help to figure out new meanings as they come along.

It is helpful to understand the thinking that takes place while learning something new on acquiring knowledge (Knowledge acquisition). It is also helpful to understand the connections, that the mind makes when it is learning something new (context cues). It is again helpful to understand, how everyday life affects, while learning there. Three skills have been identified in intelligence applied (J.Sternberg 1986). Hence, for knowledge acquisition, sensitivity to language forms an important role. Following three distinct operations may be made for learning language:

1. Selecting the relevant information that will define new word (selective encoding).
2. Combining this information to make a meaningful whole (selective combination).
3. Interrelating this information to what is already known (selective comparison).

Jeanne Chall has recently published a book on ‘model of stages of reading development’. Similar to Piaget’s model of the stages of cognitive development, it
proposes six stages; from pre reading through the advanced reading needed for college studies. The first three stages are characterized by leaving to decode and to read fluently from texts that contain 'language' and 'content' largely known to the reader. The last three stages grades four through college, are characterized by reading texts that contain unfamiliar ideas and language and that require higher level reading skills.

When compared to Piaget's theory the first three stages of reading development require concrete operations, while the last three stages require ability to engage in formal operations. It is also during Piaget's shift to formal operations that the major breakdowns occur in reading development at the junior and senior high school levels.

2.10.5 Language development at formal operational stage (12-16 years)

Piaget's concepts on the characteristics of formal operational stage have shown that thinking may have a direct connection to the process of reading development. As the contemporary issue indicates, how students actually possess and derive meaning from the word, they read may be significantly different, depending on children's level of formal operations. When the potential for abstract thought is developed, students are able to attain logical, rational and abstract strategies. 'Symbolic meanings, metaphors and similes can be generalized'. Games and simulations can be presented, so that the pupil understands their implications. During this period, writing poems is more effective than reading poems'.

According to David Asubel, concepts can be formed with or without verbal representations. He suggests that concepts are learnt in two stages. First, the child learns the representative image of the concept and then later, learns the verbal representation. This view portrays language as, adding additional meaning to an already acquired concept. Because of its focus on both images and language, Asubel's position on concept formation is consistent with the dual code theory of
‘Information processing’. He clearly recognizes that the two stages, ‘images’ and ‘verbalizing’ may occur simultaneously, especially in older children, though it need not. As children learn to increase their verbal conceptual base, their ability to comprehend written material also increases.

2.10.6 Sensitivity to language and Inductive Thinking Model

The focus of Inductive Thinking Model, developed by Hilda Taba, is on developing mental abilities and emphasizing concept formation involving cognitive tasks. Her approach to designing of teaching strategies to develop creativity and autonomous thinking has a wide range of applicability. Recent studies have shown that thinking can be learnt developmentally. Teaching strategy that helps the students to higher level of thinking involves what questions were asked, what the teacher told or sought and at what point in the proceeding. Further, this model requires the student to go through nine phases of teaching. The first three phases are concerned with concept formation, by involving the students in enumerations, grouping and labeling categories. The second three phases are related to the interpretation of data, by identifying relationship; explaining relationship and drawing inferences. The last three phases are concerned with an application of principle by hypothesizing, explaining hypothesis and verifying them. All these activities involve the students to develop their language skills. Carefully squeezed content and suggested learning experiences form the basis for language development. The social system of this model creates contusive classroom climate for learning co-operatively. A good deal of freedom for student activities motivates the student’s active conversation. The learning experiences are the basis of information to arrange the content in an effective manner. The students may use three levels of the language, lexical, syntactic, and semantic. Another important aspect of Inductive Model is that learning is incremental and thereby learning experience is arranged in small steps. These steps match the child’s ability to
assimilate and accommodate information, which provide purposeful opportunities for him to use and interpret language, relevant to his experiences.

The Inductive Thinking Model further arranges the classroom activities in a ‘logical sequence’ in advance with eliciting questions. Answering to these questions, furnishes language development. Without language, thoughts cannot be communicated. Students obtain concepts form the analysis of perceptual experiences and label them by means of words. Hence, this model gives lots of scope to language development among the children. The phases of Inductive Thinking Model built on one another to generate more and more complex mental activity and to increase the likelihood that the study of language would have a yield for their skill in writing. The second inductive activity built on the first as the student added the study of expert writers and tried to learn them. It clearly indicates that this model motivates the students to learnt language in every teaching learning activity.

2.11 THE NEED TO LEARN PHYSICAL GEOGRAPHY BY INDUCTIVE THINKING MODEL

Physical geography requires an elementary knowledge of science for its foundation. For example, principles of facts on which climate depend, instructions to use a barometer, thermometer, sundial, magnetic needle etc. In all these fields, the actual recording of atmospheric pressure, temperature, wind direction, rainfall etc. lies within the realms of geography but the study of recording instruments used forms the subject matter of other branches of science. Geography interprets the results, obtained by science. The study of various types of soil formed by weathering of different rocks is common to both science and geography. Thus, teaching of geography is highly correlated with science. Since, scientific process creates scientific thinking abilities among the students, the investigator has chosen the physical geography for her study. The ability to comprehend problems, the
ability to make inquiry and the ability to endure (Fernald 1912, Eysenck 1947) are the expected outcomes of the physical geography learning.

Further, at no other time in our history has the need to understand the environment been more urgent. The sophistication, magnitude and diversity of the ways in which we alter the biosphere continue to grow. Often in advance, and our ability to deal with any resulting side effects, the ‘Bio engineering’ of new strains of plants and animals, the removal of vast tracks of the rainforests, the extensive use of synthetic, and agricultural chemicals, and the effects of many types of pollution are just some of the ways by which the character of life on this planet is being altered. The past two decades, have witnessed a growing awareness of the effects of human activity upon our planet’s resourcer. During this period, environmental science has evolved as a multidisciplinary field of study to examine the interaction of people and their environment. Concern for the world in which we live is not the prerogative of the academic; as the ecological issues increasingly attract media attention so terms which were previously used only by environmentalists have become article of every day speech, for example CFCs, the green house effect and reactor etc. Hence, the content of curriculum is upgraded and make more challenging. It is necessary to make teachers to understand the chief features of the new upgraded curriculum with a view to develop improved teacher’s competence, better teaching skills, and a more sensitive awareness of the teaching learning process in the changed situation. Inductive Thinking Model, as described by Hilda Taba, enhances the quality of teachers, and the needs of the students. Thus, model gives freedom to adapt greater initiative and competence on the part of the schools, teachers and students. The investigator finds this model as suitable to teach vii standard physical geography lessons to the students.

Hilda Taba had developed an interest in ‘progressive education’, and ‘curriculum reform’. She integrated her beliefs in the connections between society and culture and between cognition and learning. Her theory of application of
principles, starts by having students hypothesize or predict and then explain or support their predictions. The students verify their explanations through ‘logical reasoning’. This type of ‘thinking skill’ among these students is necessary for learning physical geography. Because at no other time in our history has the need to understand the environment been more urgent. In view of above, aspects the investigator has framed her lesson plans to teach physical geography based on Inductive Thinking Model for her study.

2.12 LESSON PLAN

A careful planning of a lesson strengthens the entire teaching process. Lesson planning is preplanning or preparing to intelligently organize a learning activity to see how best children can be encouraged to acquire new information, skills and attitude and to reinforce the earlier learning. Planning includes verification of how far the plan worked or not and why. Teaching models try to improve the teacher effectiveness, enable the teacher to specify the instructional materials, needed for bringing about desirable educational outcomes, help in better designing of the curriculum, as well as create a richer classroom environment through careful planning of a lesson. Hilda Taba, in her book ‘Teachers handbook to elementary social studies’, says that by applying a strategy broadly and making procedural modifications, there is likely to be a marked improvement in the thinking skills of elementary school students as they study social topics and apply the knowledge they gain. Procedures cover translation of content into learnable tasks, discussion procedure and the formulation of hypothesis.

2.12.1 Major strategies

Major Strategies of Taba’s curriculum

- Developing concepts
- Attaining concepts
- Developing generalization
Developing concepts

- Aimed to establish a firm basis for later development of generalization.
- Concepts are building blocks for generalization.
- Students identify a number of concrete items from their experience, such as a field trip, a story they have read, units they have studied etc.
- After a suitable large list is produced, students group the items that belong together and give reasons for doing so.
- Students then label their groups.
- Teacher elicits students questioning, identifying and grouping responses.

Questioning (Example)

1. What did you see at the fire station?
   - Students provide items.
   - Teacher places items on display, writes names of items on board, paper or transparencies.

2. Do any of these items seem to belong together?
   - Students find similarities as a basis for grouping items.
   - Teacher marks with symbols or underlines in colored chalk, crayons etc.

3. Why would you group these items together?
   - Students verbalize common characteristics of item grouped.
   - Teacher seeks clarification wherever necessary.

4. What would you call these groups you have formed?
   - Students verbalise a label (category) that is appropriate.
   - Teacher records the labels on paper, chalk board etc.

5. Could some of these items belong to more than one group?
   - Students state different relationships.
   - Teacher records on notes.
6. Can anyone say in one sentence something about all these groups?
   - Students offer suitable summary sentence.
   - Teacher reminds students to take into consideration of all the groups.

*Attaining concepts*

Difference between building concepts and attaining concepts lies in degree of control.

a. Concept formation (inductive)
   - Concept labels are the students own
   - They label a group in the most appropriate way.

b. Attaining concepts (deductive)
   - Students are first given a concept word to say and recognize.
   - Students are then asked to recognize when examples fit the concept.
   - Attaining concepts can be used in unit to clarify word meanings that are important for continuity of learning.
   - Using concept attainment.
   - Making a chart on the board, on paper or on a transparency.
   - Asking students to suggest examples that fit the category named.

*Developing Generalizations (interpretation of data)*

1. The end product of a process:
   - Abstraction from a group of items following such processes as building concepts or concepts attainment.
   - Generalizations are verbalized in the form of sentences rather than in single word as in concepts.
   - Higher level of thinking

2. Generalizations can take in two forms:
   - Interpretations which are statements of relationship from given data.
   - Inferences, which are statements of relationship that go beyond the given data.
Questioning (Example):
- What do you notice about the data? Why did this or that happen?
- What do you think this means?
- Do you notice any connections within the records or across the data?
- What makes you think this?
- What can you conclude?

3. Applying generalizations (Application of principles):
   Questioning (Example):
   - What if?
   - Why do you think, this or that would happen?
   - Based on the data. Would these conditions be logical?

### 2.12.1 A rationale for using database in the teaching model

Databases are wonderful learning tools because they embody so much of the learning process. Once teachers begin to understand how to apply this technology to curricular projects, learning truly becomes a process of give and take. Data can be gathered from the following ways:

1. Obtaining background: Students need to read on research designated curricular topics. This includes going on field trips, watching videos, and listening to visitors to the classroom.

2. Planning: students participate is brainstorming that gives them, the opportunity to recall large amounts of data. Recalling data also serves to develop concepts.

3. Organising: students learn and apply organizational skill when they plan a database.

4. Gathering facts: students extend their research skills as they fit facts into categories.

5. Using tools: students learn to create and use a database to store data in an organized efficient manner.
6. Questioning: students learn to formulate questions that result in the extraction of information from the database.

7. Hypothesizing: students learn to state and test their own hypotheses.

8. Analyzing: students quickly understand, and make relationships with the data.

9. Evaluating: students understand the difference between data and information. Using a database as a teaching tool is quite different from the 'word processors' within instruction. Just as the use of word processing requires planning, the use of database as a tool requires strategies that go beyond a few afternoon sessions in the computer lab. It is important, therefore to incorporate the Inductive Model of Hilda Taba, into the learning process in order to succeed in integrating databases with the curriculum and lesson planning.

2.12.2 Taba’s questioning strategy design

**Table 6**

<table>
<thead>
<tr>
<th>S. No.</th>
<th>Level of questions</th>
<th>Thinking skill</th>
<th>Sample of questions</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>Deductive reasoning</td>
<td>Evaluation</td>
<td>Did it work? How successful was it? Were the results as predicted?</td>
</tr>
<tr>
<td>2.</td>
<td>Inductive reasoning</td>
<td>1. application either hypothetical or actual 2. making generalizations (conceptualize) 3. drawing inferences about relationship affecting identifications and perception</td>
<td>If …then? Suppose……that? What conclusions can you draw? Why do you think? What was your reactions? How did it make you? What happened? What do you known about? What did you see?</td>
</tr>
</tbody>
</table>
The above table was created by Hilda Taba on questioning strategy design, based on the work of Piaget. She explains that careful questioning is necessarily be planned by the teachers, to help students at many different levels and in many different classes to progress higher levels of thinking and understanding.

Teachers can plan discussions, moving from a level of inferences, applying information to new situations, and eventually to evaluate information. When questioning a group, allow a person to contribute just one response in order to involve more people.

The investigator has observed the above strategies and procedures of Hilda Taba, for framing her lesson plans to teach vii standard students. Since, Hilda Taba's cognitive tasks lend themselves to integrate in every curriculum, the investigator has integrate these cognitive tasks in teaching physical geography to Standard VII students, in her research.

2.13 CONCLUSION

This chapter has dealt with the conceptual framework of the present study. In this chapter academic achievement, concept formation, logical reasoning and styles of thinking were conceptualized in the context of the present study. The review of literature will be discussed in the forthcoming chapter.