THEORETICAL OVERVIEW

2.1 Components of Teaching
2.2 Emergence of Models of Teaching
2.3 Concepts for Describing a Model
2.4 The Information Processing Approach
2.5 The Information Processing Models
2.6 Concept Attainment Model
2.7 Advance Organiser Model
2.8 Inductive Thinking Model
THEORETICAL OVERVIEW

The teaching profession has the largest number of members as compared to any other profession in any country and the teachers are the main instruments in implementing the policies formulated to achieve a breakthrough in the quantitative expansion and qualitative improvement of education.

Teaching as highlighted by Joyce and Weil (1980) is a process which stresses the importance of teaching-learning environment created out of the interaction between teachers and the pupils. A process always has a series of activities that takes place in a logical order. Hough and Duncan (1970) make it clear that the teaching is a process which has a series of activities which takes place logically and sequentially. According to them, teaching comprises four phases – a curriculum planning phase, an instructing phase, a measuring phase and an evaluating phase. Hence it is clear that teaching does not take place in vacuum. It involves certain components, the human, material and the skill based components.

2.1 Components of Teaching

Three major components can be found involved in the teaching act, that is, the teacher, the student and the curriculum. Whereas the teacher and student are the human components, the curriculum constitutes the material component. Strategies adopted for effective
teaching are the skill based component. All these components together create a teaching-learning environment which is geared to achieve instructional objectives. In any human act, it is the strategy which determines the achievements of objectives formulated for the act. Similarly in the teaching process, the achievement of the instructional objective depends on the method adopted for teaching.

2.2 Emergence of Models of Teaching

Models are prescriptive teaching strategies designed to accomplish particular instructional goals (Eggen Paul, D. et al., 1979). Models differ from general teaching strategies in that models are designed to reach specific goals. The use of models requires an ability to specify precise learner outcomes so that a specific model can be selected to match a particular goal.

During the last two decades, a lot of attention has been paid to improve the process of teaching, resulting in the development of a number of models of teaching by various researchers. All these models are based on empirical researches, theories, postulates and hypothetical propositions. The work done by Joyce and Weil is monumental in this area.

Models of teaching emerged out of the search by Joyce and Weil (1972) to find a variety of approaches or strategies of teaching. Models of teaching are really models of learning. As we help students acquire information, ideas, skills values, ways of thinking and means of
expressing themselves, we are also teaching them ‘how to learn’. In fact, the most important long-term outcome of instruction may be the students’ increased capabilities to learn more easily and effectively in the future both because of the knowledge and skill they have acquired and because they have mastered learning processes.

The most comprehensive review of teaching models is that of Joyce and Weil who has identified twenty-four models of teaching which are classified into four basic families based on the nature, distinctive characteristics and effects of the models. These four families are,

1. **The Information-Processing Family**

   This family of models aims at fostering the information processing ability in the learners. These models help the learners to seek and master information, organize it, build and test hypotheses.

2. **The Personal Family**

   This family of models stresses on personal development of an individual and development of selfhood. They are most concerned with human feelings and emotions and try to move towards the development of an integrated functioning self.

3. **The Social Family**

   One of the main aims of education is to prepare worthy citizens. These models strive to enhance personal and social life so that a democratic social order prevails in the society. These models combine learning and social living.
4. **The Behavioral Systems Family**

These models emphasize changing external behavior of learners in terms of visible behavior rather than their underlined behavior.

Education is aimed at the total development of the child which includes the development of cognitive, affective and psychomotor domains. Since each model coming under a particular family has its own objective, the teacher has to select the model which is most suitable to realise his/her objective.

### 2.3 Concepts for Describing a Model

To translate a theoretical model into practical teaching form, a set of four concepts are used.

2.3.1 **Syntax**: It is described in terms of sequences of activities which are called phases. Each model has a distinct flow of phases.

2.3.2 **Principles of Reaction**: They guide the teacher’s response to the learner, they tell the teacher how to regard the learner and respond to what he does.

2.3.3 **Social System**: It provides a description of the student and teacher role and relationships and the kind of norms that are encouraged. The leadership role of the teacher varies greatly from model to model.
2.3.4 **Support System**: This refers to the additional requirements beyond the usual capacities and technical facilities necessary to be implemented in a model.

2.3.5 **Effects of the Models**

The description of the effects of model is categorized as the direct or instructional effects and the indirect or nurturant effects. The nurturant effect comes from experiencing the environment created by the model. The details regarding “Models of Teaching” are summarized in figure 2.1

*Figure 2.1 Models of Teaching*

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<tr>
<th>MODELS OF TEACHING</th>
<th>1. Instructional Strategies</th>
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<tbody>
<tr>
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<td>2. Coherent Theoretical Basis</td>
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<tr>
<td></td>
<td>3. Empirically Established</td>
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<td>4. Aims at both proximate and ultimate aims</td>
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<th>The Concept and Definition</th>
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<tbody>
<tr>
<td>1. Syntax</td>
</tr>
<tr>
<td>2. Social System</td>
</tr>
<tr>
<td>3. Principles of Reaction</td>
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<td>4. Support System</td>
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<thead>
<tr>
<th>Structure of Model</th>
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<tbody>
<tr>
<td>1. Information Processing</td>
</tr>
<tr>
<td>2 Social Interaction</td>
</tr>
<tr>
<td>3. Personal Models</td>
</tr>
<tr>
<td>4. Behavioural Models</td>
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<tr>
<th>Families of Models</th>
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<tr>
<td>1. Instructional Effect</td>
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<td>2. Nurturant Effect</td>
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2.4 The Information Processing Approach

Cognition is the act or process of knowing. There are three basic approaches to understanding cognition. One is the psychometric approach which measures quantitative changes in intelligence as people mature. The second approach is the piagetian approach, which emphasizes the qualitative changes in the way people think as they develop. The third approach is the information-processing view which examines the progressive steps, actions and operations that take place when people receive perceive, remember, think about and use information. The steps in information-processing are illustrated in figure 2.2.

Information-processing has often been compared to the actions of a computer. Information is coded and fed into a computer in an organized way and then it is stored in the memory banks. When any of that information is required the computer is asked to produce it. The machine searches for the relevant information and reproduces or prints out the items requested.

Information-processing by children is basically similar but far more sophisticated. The child receives information, organizes it, stores
it, retrieves it, thinks about it and combines it to answer questions, solve problems and make decisions. The most elaborate computer used in creating artificial intelligence cannot match the capacity of the human mind and the nervous system in the input and output of information. As each year passes, the child’s ability to process information increases, partly because of the continued development of the brain and the nervous system and partly because of the learning experiences and practice that improve mental abilities and strategies (Teyler and Fountain, 1987, Goodman and Haith, 1987). The cognitive view of learning sees people as active processors of information. They initiate experiences that lead to learning, seek out information to solve problems and recognize what they already know to achieve new learning. Instead of being passively influenced by environmental events, people actively choose, practice, pay attention, ignore and make many other responses as they pursue goals.

2.5 Information Processing Models

Information processing models are teaching strategies based on information processing theory that are designed to help students to learn content at the same time as they practice thinking skills under the guidance and direction of an active teacher.

In recent years considerable emphasis has been placed on the school’s role in the development of student’s thinking skills. (Link,1985; Costa,1985). Educators are recognizing that this no longer
sufficient to simply teach the students what they should know, but in addition, they must be taught how to know. Information processing specifically provides one valuable framework for addressing the development of students’ thinking skills and abilities (Steinberg, 1985; Rosenshine & Stevens, 1986).

Optimal development of student’s intellectual abilities occurs in the classroom when learners are provided ongoing opportunities to practice these skills across diverse areas of curriculum.

Thinking skills have now become an issue of major concern to educators in our country and around the world (Beyer, 1984; Costa, 1985; Link, 1985) perhaps in response to the long standing emphasis on basic skills, the need for people to cope with the technological change, the increasing information orientation of our society and the world’s ever expanding body of knowledge.

Beyer (1984) describes thinking skills as existing in three major categories (1) the broad skills such as problem solving (2) discrete and basic operations or processes and (3) a combination of the two resulting in critical thinking.

Our senses are our first and most basic mechanism for gathering information. Items of information acquired in this way are called observation. Conclusions formed on the basis of observation are called inferences. Generalizing inferences can be defined as conclusions
that summarize a series of observations to suggest a pattern on which explanations and predictions can be cleared.

Observing, explaining, predicting and generalizing are the foundation on which thinking is based. However there are other important skills that derive from those fundamental ones. They are, *comparing*, which is the skill that asks learners to identify similarities and differences in information and *hypothesising* which is an extension of the process of generalizing and allows learners to extend their thinking to another as yet unconsidered level. Critical thinking can be viewed as a derived skill that results from the ability to form valid generalisations, explanations, predictions, hypothesis and comparison or the ability to assess the validity of existing statements.

Reasoning can be described as proceeding in one of the two ways. We either summarize a series of observations to form a pattern, or we use pattern to explain or predict a particular event. The former is called inductive reasoning, which is the process involved in making generalizing inferences and the latter is deductive reasoning. Forming inferences and inductive and deductive reasoning are inextricably intertwined.

The product of thinking is called knowledge or content. Everything we teach in the school can be described in terms of fundamental forms of knowledge. These forms are facts, concepts and generalisations. Facts can be defined as the forms of content that are
singular in occurrence’ which occur in the past or present and which have no predictive value. A concept is an abstracted notion that is based on a class of objects, events or ideas with common characteristics. Generalisations can be defined as relationships between two or more concepts that usually can be described in cause-effect terms, describe patterns and have explanatory and predictive value.

Information processing emphasises the process the individual uses to solve problems. Memory processes and problem solving have been the focuses of information processing approach. Information processing models emphasise ways of enhancing the human being’s innate drive to make sense of the world by acquiring and organizing data, sensing problems and generating solutions to them. Some models provide the learner with information and concepts, some emphasize concept formation and hypothesise testing, and still others generate creative thinking. The major details regarding the information processing family are summarized through figure 2.3
2.6 Concept Attainment Model

The concept attainment model (CAM) is an inductive thinking strategy designed to help students of all ages learn concepts and practice analytical thinking skills. The design of this model first suggested by Joyce and Weil (1972) is based on the research of Jerome Bruner and his associates who investigated how different variables affected the concept-learning process. These researchers originally
entitled their work, A Study of Thinking (Bruner, Goodnow & Austin, 1956).

2.6.1 Nature of Concepts

Concepts are the building blocks for the structure of knowledge of various academic disciplines. They are the form of data or form of content that result from the categorization of a number of observations. Concept is a mental representation or mental picture of some object of experience. It represents a category of objects which share common properties.

2.6.2 Components of a Concept

According to Bruner, a concept has five elements.

1. Name: The name is the term given to a category. Once a concept is established, it is named so that we can refer to it symbolically. The conceptual understanding process is not one of guessing names but to get the attributes of a concept clear.

2. Attributes: Attributes refer to the characteristics of a particular concept that help to distinguish instances of the concepts from non-instances. These characteristics or attributes may be relevant, irrelevant or criterion related. Relevant attributes are common to all example of a concept where as he irrelevant attributes vary among example of the concepts. ie, they are associated with certain examples of a concept but not with other examples of same concepts (Harris & Harris, 1973). Criterion related attributes are
those relevant attributes that distinguish the concept from superordinate or co-ordinate concepts. Essential attributes are attributes critical to the domain under consideration. These attributes are present in all examples of a concept. Non-essential attributes are those attributes which may not be relevant to the category itself.

3. Exemplars: Brunner used the term ‘exemplars’ to indicate the array of all instance of the concept. Positive exemplars are those instances which contain all the critical attributes and those instances that do not contain all the critical attributes are called negative exemplars. ie, the absence of one or essential attributes makes an instance a negative exemplar of the concept. It is by comparing the positive exemplar with the negative ones that the concept is learnt.

4. Attribute value: it refers to the degree to which an attribute is present in any particular example.

5. Rule or Definition: it is a statement specifying the essential statement merely reflects successful utilization other elements of a concept. A rule should evolve at the end of concept attainment process.

For Bruner, concept learning is a form of classification. According to him, categorization activity has two components- the act of concept formation and the act of concept attainment. Concept formation is the first step towards concept attainment. Concept formation is the
act by which new categories are formed while concept attainment is the process of finding and defining attributes that distinguish examples from non-examples of the class.

### 2.6.3 Levels of Concept Attainment

Klausmeier and his associates conducted a series of experiment since 1960 dealing with both external and internal conditions of concept learning and behavioral analysis of concepts from different areas of school learning. On the basis of these studies, Klausmeier (1971) specified mental operations required for the proposed model of conceptual learning and development. Later on the model was modified (Klausmeier & Allen, 1978) it includes four levels of concept attainment. The four levels are hierarchical in nature and involve specific cognitive operations. The four levels of concept attainment are given in figure 2.4

![Fig. 2.4 Levels of Concept Attainment](image-url)
Concrete level: the attainment of concepts at this level requires attending to the distinctive features of an object and forming a memory image, which represents the object as a unique bundle of features. It involves only the discrimination of an object from other objects.

Identity level: this level is attained when the individual is able to generalize the characteristics of objects in different perspectives or sensed in different modality.

Classificatory level: This level is attained when the individual is able to treat at least two different instances of the same class as equivalent, even though he may not be able to describe the basis for his response. The individual is able to classify a large number of instances but cannot accurately describe the basis of his classification on grouping in terms of the defining attributes.

Formal level: A concept at the formal level is attained when the individual can give the name of the concept, name its intrinsic and socially accepted defined attributes, can accurately give example as belonging or not belonging to the set, can state the basis for there inclusion in terms of the defining attributes.

Every teacher provides information to the pupils in the class. Whatever information is provided, can be classified into three categories- facts concepts and generalisations. The process of learning concept is different. Researchers have identified different teaching models for teaching effectively different type of content. The concept attainment
model developed by Joyce and Weil (1980) is quite suitable for teaching concepts.

There are three variations of concept attainment model. Each has a slightly different syntax but all are developed from different conceptual base.

2.6.4 Reception Oriented CAM: in this model the students are more receptive than active. The teacher has a more dominant role, acts as recorder, keeping track of the hypotheses and supplies additional examples. It is more direct in teaching students the elements of a concept and their use in concept attainment.

2.6.4.1 Syntax of the Reception Model of Concept Attainment

Phase 1: Presentation of Data and Identification of Concept.

- teacher presents labeled examples
- students compare the attributes in positive and negative exemplars
- students generate and test hypotheses
- students state a definition according to the essential attributes

Phase 2: Testing Attainment of the Concept

- students identify additional unlabeled examples
- teacher names the concept and re-states definition according to essential attributes
- students generate examples
Phase 3: Analysis of Thinking Strategies

- students describe thoughts
- students discuss role of hypotheses and attributes
- students discuss type and number of hypotheses

In the first phase of the reception model, the teacher presents positive and negative exemplars in the pre-determined sequence. This data may be in the form of pictures, anecdotes, sketches, diagrams, events or any other illustrations. The pupils are told that there is one idea in common in all the positive exemplars and that they have to compare and justify the attributes and form some hypotheses about the concept. When the pupils have analyzed the examples and hypothesized, the teacher asks the students to state a definition according to the essential attributes.

In phase 2, the teacher presents unlabeled examples. The students identify them as positive or negative. The teacher asks for reason and confirms their hypotheses. When the students have attained the concepts the teacher names the concepts. To test the attainment of the concept further the teacher asks the pupil to generate examples and label them as positive and negative instances of the concept.

In the third phase of the model, the teacher analyses the thinking strategies employed by the students.
2.6.4.2 Thinking Strategies

In the reception oriented model, mainly two kinds of thinking strategies are used- wholist and partist. The wholist strategy is to take the first positive instance of the concept as a whole. I.e., comparing all the attributes of the first positive instance to those subsequent instances and modify the hypotheses and subsequent decision depends on the attributes similarity and difference between the first positive instance and the subsequent ones.

In the partist strategy the choice of hypotheses is based on only part of the initial example. If the initial hypotheses are not confirmed then the partist refers back to all prior instances and chooses another hypothesis.

2.6.5 Selection Oriented CAM

This model places responsibility of concept attainment and attribute tracking in the hands of the students. An example is not labeled until the student asks whether it is a yes or no example. The students control the sequence of the examples.

2.6.5.1 Syntax of the Selection Model of Concept Attainment

Phase 1: Presentation of Data and Identification of Attributes

- teacher presents unlabeled examples
- Students inquire which examples are positive, based on the first positive instant given by the teacher.
- Students generate and test hypotheses.
Theoretical Overview

**Phase 2: Testing Attainment of the Concept**
- students identify additional unlabeled examples
- Students generate examples.
- Teacher confirms hypotheses, names, concept and restates definition according to essential attributes.

**Phase 3: Analysis of Thinking Strategy**
- students describe thoughts
- students discuss the role of hypotheses and attributes
- students discuss type and number of hypotheses.
- teacher evaluates the strategies.

The procedure under the selection strategy begins with the presentation of all the instances representing the various combinations of attributes of a concept. The student is then told by the teacher that some of the examples presented before him illustrate the concept in mind and the others do not. The teacher begins with a positive example. The pupil's task is to select examples from those presented to them, test them one at a time against the first positive example and label them as positive or negative example of the concept in the teachers mind. The pupils may select the examples in any order, but one at a time. The pupils thus generate hypotheses, test them and arrive at the definition of the concept. In the third phase, while analyzing the thinking strategies the selection thinking strategies.
2.6.5.2 Thinking Strategies

According to Bruner and his associates, there are four strategies used in selection oriented CAM.

1. Simultaneous Scanning
2. Successive Scanning
3. Conservative Focusing
4. Focus Gambling

A Simultaneous Scanner hypothesizes more than one concept with the first instance and his choice of next instance to test will be determined by the elimination of as many hypothetical concepts as possible instance chosen.

A Successive Scanner forms concept hypotheses from the given positive instance and then tests it’s against other examples. The disadvantage here is that there is no assurance of giving maximum information possible. The advantage is the relief from cognitive strain as limited inference is required.

A student with the Conservative focusing strategy finds a positive instance and chooses instances that alter one attribute at a time. By choosing a particular instance as focus the person decreases the complexity and abstractness of the task of keeping of information he has encountered. Hence there is relatively more cognitive economy.

In the Focus Gambling strategy one uses a positive instance as a focus and changes more than one attribute at a time. The strategy
makes use of fewer test choices. But there may be equal chances of requiring more test choices and therefore the name Focus Gambling.

2.6.6 Unorganised Material Model

This model is much more a group discussion than an instructional game like the reception and selection strategies. The teacher’s role is to facilitate discussion and ensure that it focuses on the development of a concept in the material. Syntax of this model of CAM is quite different from that of the other two strategies. It consists of two phases. Phase 1 relates to the description of the concept and phase 2 relates to the evaluation of the concept.

2.6.7.1 Social System

The model has a moderate structure. The teacher assumes a major role initially in choosing the concept, selecting and organizing or sequencing data. The teacher controls action but with subsequent phases, student interaction is encouraged. In the reception oriented model, the structure moves from high to moderate. In the selection oriented model, it is relatively structured with students assuming more initiative for inductive process.

2.6.7.2 Principles of Reaction

The teacher has to help the students for the process of hypothesising in the beginning and then for analysts of the concept and thinking strategies. The teacher should encourage analysis of merits of
various strategies rather than attempting to seek the one best strategy for all pupils in all situations.

2.6.7.3 Support System

Well organized reference material is the essential support required for this model. Carefully selected and organised materials and data in the form of discrete units easily serve as examples.

2.6.7.4 Effects of the Model

Understanding specific concepts, the nature of concepts provide practice in inductive reasoning and opportunities for improving student’s concept building strategies. The nurturant effects come from experiencing the environment created by the model. These effects are sensitivity to logical reasoning in communication, tolerance of ambiguity (but appreciation of logic and awareness of alternative perspective. The instructional and nurturant effect of CAM is given in figure 2.5
2.7 Advance Organiser Model

Advance organiser model of teaching is based on the theory of meaningful verbal learning by David P. Ausubel. His theory of meaningful verbal learning deals with three concerns (1) how knowledge is organized (curriculum content) (2) how the mind works to process new information (learning) and (3) how teachers can apply these ideas about curriculum and learning when they present new materials to students (instruction).
According to Ausubel, whether or not material is meaningful depends more on the preparation of the learner and on the organisation of the material than it does on the method of presentation.

Meaningful learning occurs when the ideas in a new schema are connected not only to each other but also to previously established schemata in logical manner. He feels that when the discovery learning can be used for teaching thinking skills, teacher should use a deductive approach which is highly structured and which allows students to explore relationships in the content. Though he favors teacher centered, deductively sequenced teaching sessions, he is adamantly opposed to passive learning on the part of the student. The major task freeing the student is to actively think about the new material to be learned and helping them to find relationships not only within the new content but also with the content previously learned.

**Identifying Goals**

Goals of this model is to help students develop schemata, or in other words, to structure knowledge. Rather than teaching one particular concepts or generalisation it is designed to teach organiser bodies of content (schemata) or to help learners organise already understood concepts and generalisations to an overall schema.

To help students in this process, Ausubel suggests that the teachers employ three concepts: advanced organiser, progressive differentiation and integrative reconciliation.
When the student approach a learning task with an attitude that they can make sense out of information, i.e. when they have a meaningful learning set – they are more likely to learn that information meaningfully.

Researchers have identified a number of factors that facilitate student’s learning from expository est. including these.

1. Connection to prior knowledge
2. Advanced organisers
3. Organisations
4. Visual Aids

Long-term memory storage and retrieval are easier when students relate new information to things already stored in long-term memory. Yet unfortunately, students often fail to connect the new things they learn in school with the things they have previously learned (Perkins & Simmons, 1988, Prawat, 1989). When we begin a lesson by reminding students about the relevant information they already have, we help them to make those critical, meaningful connections. By using an analogy to compare new material to things with which our students are already familiar. We can help them store that material more meaningfully and retrieves more meaningfully and retrieve it more easily. (Newby et al., 1994; Zook, 1991)
Advance Organisers

Many students try to learn a body of information as a list of isolated facts with little or no relationship to one another (Meyer et al., 1980). As teachers we can help students better organise and interrelate the information in a lesson by providing an advance organiser i.e., by giving an introduction that describes an overall organisational scheme for the body of knowledge we are presenting (Ausubel et al., 1978; Corkill, 1992; Meyer, 1979a, 1979b). An advance organiser typically includes the major concepts and ideas of a lesson and shows how these concepts and ideas are related to one another.

Organisation: An advance organisation starts students on the right track in terms of organising new material. But an equally important strategy is to introduce each new idea within the lesson in such a sequence that the important relationships among the various ideas are crystal clear. In other words, we can help students organise material in such a way by presenting the information using that same organisational structure (Tennyson & Rothen, 1980; Tennyson & Cocchiarella, 1986).

Visual Aids: Visual imagery can be highly effective way of storing information in long-term memory. Supplementing verbal explanation with visual aids should promote more effective long term memory storage and retrieval.
2.7.1 Description of the Model

2.7.1.1 Syntax

The model has three phases of activity.

Phase 1: Presentation of Advance Organiser

Phase 2: Presentation of Learning Material

Phase 3: Strengthening Cognitive Organisation

Phase 1: Presentation of Advance Organiser

At this phase the aims of the lessons are made clear and then the organiser is presented. The concepts, principles, etc. that have to act as subsumers have to be clarified and illustrated. The teacher should ensure the required cognitive structure by discussion, questioning and feedback. The presentation of an organiser need not be lengthy, but it must be perceived, clearly understood, and continually related to the material it is organizing, it is useful to illustrate the organiser in multiple contexts and to repeat it several times, particularly any new or special terminology.

Phase 2: Presentation of Learning Material

The learning material is presented in the form of lectures, discussions, films, experiments, or reading. Present the minor concepts in the order using the principle of progressive differentiation. During the presentation, the organisation of the learning material needs to be made explicit to the students so that they have an overall sense of direction and can see the logical order of the material and how the organisation
relates to the advance organiser. Use of pictures, aids, films, examples, analogies, action etc, could be helpful for making learning meaningful.

**Phase 3: Strengthening Cognitive Organisation**

The purpose of phase three is to anchor the new learning material in the student’s existing cognitive structure. Ausubel identifies four activities for the reworking of the new material.

1. **Promoting Integrative Reconciliation**

   There are several ways to facilitate reconciliation of the new material with the existing cognitive structure. The teacher can:

   (i) remind students of the ideas (larger picture)

   (ii) ask for a summary of the major attributes of the new learning material

   (iii) Repeat precise definitions

   (iv) Ask for differences between aspects of the material, and

   (v) Ask students to describe how the learning material supports the concepts or proposition.

2. **Promoting Active Reception Learning**

   Active reception learning can be promoted by:
(i) asking the students to describe how the new material relate to the organiser
(ii) asking students for additional examples of the concepts or propositions in the learning material
(iii) asking students to verbalize the essence of the material, using their own technology and frame of reference, and
(iv) asking students to examine the materials from alternative points of view.

3. Eliciting a Critical Approach to Subject Matter

A critical approach to knowledge is fostered by:

(i) asking students to recognise assumptions or inferences that have been made in the learning material
(ii) asking to judge and challenge these assumptions and interferences, and
(iii) asking to reconcile contradiction among them.

4. Clarification

The teacher ensures meaningful learning by clarification of doubts raised by pupils. It is not possible or desirable to use all these techniques in one lesson. Constraints of time, topic and relevance to particular learning situation will guide their use.

2.7.1.2 Social System

The teacher has the control of the intellectual structure, since it is continually necessary to relate the learning material to the
organisers and to help students differentiate new material from previously learned material. During the first two phases it is highly structured, but during the third phase the learning situation is much more interactive, with students initiating many questions and comments.

2.7.1.3 Principles of Reaction

The teacher reacts to pupil’s reactions by way of giving clarification differentiating or by helping them to recon ciliate with existing knowledge. A close relationship exists between teacher and students.

2.7.1.4 Support System

Well organised learning material which includes the advanced organiser and the new items to be successively differentiated, forms the most important support. Charts, models, film strips, etc, are also used.

2.7.1.5 Instructional and Nurturant Effects

The important instructional effects are:

(i) formation of conceptual structures
(ii) meaningful assimilation of information and ideas

The nurturant effect includes the following:

1. ability to learn from reading, lectures and other media used for presentation
2. interest in enquiry
3. habits of precise thinking.
Instructional and nurturant effects of Advance Organiser Model is given in figure 2.6

**Figure 2.6 Instructional and Nurturant Effects of Advance Organiser Model**

### 2.8 Inductive Thinking Model of Teaching

Inductive thinking model is based on the theory of Hilda Taba who has developed a series of teaching strategies designed to help develop inductive mental processes, especially the ability to categorize and to use categories.

Hilda Taba built her approach around these assumptions.
1. Thinking can be taught. By teaching she means helping the students to develop inductive thinking ability.

2. 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. They organize the data into conceptual systems, relating points in the data to each other, generalizing from relationship they discover and making inferences to hypothesis, predict and explain phenomenon.

3. Processes of taught evolve by a sequence that is ‘lawful’. Taba postulates that, to master certain thinking skills, a person must first master certain earlier ones, and this sequence cannot be reversed. Therefore, “this concept of lawful sequences requires teaching strategies that observe these sequences” (Taba, 1966, pp.34, 35).

   The inductive model is a straight forward and powerful strategy designed to develop the thinking skills of observation, comparing, finding patterns and generalizing while at the same time teaching specific concepts or generalizations. In addition, this model has the extrinsic advantage of promoting high levels of interaction and increased student motivation. Its effectiveness depends on the teacher as an active leader as students process information.

   There are two primary differences between teaching a concept and teaching a generalization. While non-examples are important while
teaching a concept, generalizations are often taught without the use of non-examples. The second difference exists in their application. We apply the concept by giving the pupils additional examples to analyze and then asking them to supply their own. On the other hand, students should apply a generalisation by asking for additional examples or using it to explain an observation on a set of observations.

2.8.1 Three Teaching Strategies

Taba identifies three inductive thinking skills and then describes three thinking strategies to develop them. The first one is the basic thinking strategy, is concept formation, the second is interpretation of data and the third is the application of principles.

Strategy 1: Concept Formation

This strategy involves (i) identifying and enumerating the data relevant to a topic or problem (ii) grouping these items into categories whose members have common attribute and (iii) developing labels for the categories. To engage students in each of these activities, Taba invented teaching moves in the form of tasks given to the students.

Strategy 2: Interpretation of Data

Taba’s second teaching strategy is built around the mental operations; she refers to as interpreting, inferring and generalising. Students build hypotheses about relationships inferring causation and explore these hypotheses to build generalisation.
Strategy 3: Application of Principles

This strategy follows from 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. It is the task of predating consequences from conditions that have been established, at each stage, students would be require to expand their capacities to handle information, first developing new concepts, then developing new ways of applying established principles in new situations.

The first phase of this strategy requires students to predict consequences, explain unfamiliar data or hypothesise. In the second phase students attempt to explain or support the prediction or hypotheses. In the third phase, students verify these predictions or identify conditions that would verify the predictions.

Begin by leading the students through activities based on data sets presented to them and in later lessons teach them how to create and organise data set.

Application: Since each of Taba’s teaching strategy is built on a particular mental or cognitive task, the primary application of the model is to develop thinking capacity. 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 includes the
creative processing of information, as well as the convergent use of information to solve problems.

The model causes students to collect information and examine it closely to organise it into concepts and learn to manipulate those concepts used regularly. The strategy increases the student's abilities to form concept efficiently and also the perspectives from which they can view information.

Teaching strategy forms the heart and soul of teaching.

2.8.2 Description of the Model

2.8.2.1 Syntax

Strategy 1: Concept Formation

Phase I: Enumeration and Listing

Phase II: Grouping

Phase III: Labeling and Categorising

Strategy 2: Interpretation of Data

Phase IV: Identifying Critical Relationships.

Phase V: Exploring Relationships

Phase VI: Making Inferences

Strategy 3: Application of Principles

Phase VII: Predicting Consequences, Explaining Unfamiliar Phenomena

Phase VIII: Explaining or Supporting the Predictions

Phase IX: Verifying the Prediction
2.8.2.2 Social System:

In all the three strategies, the atmosphere of the classroom is cooperative with a good deal of pupil activity. Since the teacher is generally the initiator of phases and the sequence of the activities is determined in advance, he or she begins in a controlling though cooperative position. However as the students learn strategies, they assume greater control.

2.8.2.3 Principles of Reaction

Teacher matches tasks to students’ level of cognitive activity and determines students’ readiness.

2.8.2.4 Support System:

Students need raw data to organise and analyse.

2.8.2.5 Instructional and Nurturant Effects

The inductive thinking model is designed to instruct students in concept formation and simultaneously to teach concepts. It nurtures attention to logic, to language, and the meaning of words and to the nature of knowledge. The instructional and nurturant effects of inductive thinking model are given in figure 2.7.
Theoretical Overview

Figure 2.7 Instructional and Nurturant Effects of Inductive Thinking Model