Teaching the young ones is one of the noble occupations which have significantly contributed towards human upliftment by providing knowledge skills and motivation. Teaching, during the recent times have become a specialised profession mainly due to the impact of knowledge explosion, scientific and technological developments, research experiences, multiple goals of education and rising aspirations of the people. No single approach to teaching is appropriate in all situations, consequently, effective teaching requires alternative approaches. Joyce Bruce and Marsha Weil (1980) precisely stated that strength in Education resides in the intelligent use of powerful variety of approaches matching them to different goals and adopting them to the students styles and characteristics. Competence in teaching stems from the capacity to reach out to different children and to create a rich, comprehensive and facilitating environment for them.

Simply 'Teaching as telling or communicating' something to others, does not hold good in the present world. In its deeper meaning teaching is related with "Teaching- learning Evaluation process" which is guided by the formulated objectives. In this context Brubacher John (1939) said, "Teaching is an arrangement and manipulation of a situation in which there are gaps and obstructions which an individual will seek to overcome and from which one will learn in the course of doing so." Emidsun Edmund (1967) narrated, that teaching is an interactive process, primarily involving classroom talk which takes place between teacher and pupils and occurs certain definable activities."
To achieve the educational objectives or goals different teaching strategies must be practised by the teacher. Teacher can repeat the activities with variations on some concept till he gets convinced that students have learnt basic principles. Ward et al (1996) rightly says, that simply presenting the correct answer robs students of the opportunity to construct meaning and make connections between observations and concepts.

The teacher can guide the students to construct the real concept. He/ She can provide opportunities for students to apply the concepts to the new situations. As Gil Perez (1996) states, "Science of learning is a conceptual change in three basic concepts:

(i) An elicitation phase of pupil's idea, making them conscious of the plausibility and productivity of those ideas;

(ii) A reconstructing phase, creating cognitive conflict, generating pupils dissatisfaction with their current ideas and preparing them for the introduction of scientific conceptions; and

(iii) An application phase, giving opportunities for using the new conceptions in different contexts and consolidating them.

When teacher consistently use questions that probe, classify and explore the relationships between students prior experiences and new classroom experiences, students develop more accurate science concept. To meet the individual needs and the developmental needs of the society we have to change the traditional methods of teaching. This change is affected directly or indirectly by the contribution of new knowledge generated by experimentation. This has great impact on educational methods of teaching-learning process.
Teaching is simulating and directing of students towards different methods. Thus, it requires a change in teachers to use a variety of techniques in their teaching. Models of teaching which are presently available, are not substitute for teaching skills. They are a tool for making teaching more systematic and efficient. Models of teaching provide guidelines for teaching not only content (product), but the skills of learning (process). Art of teaching involves ability to combine the skills and models to adopt to the learners and the classroom situation. In this context Bruce R. Joyce (1980) states that school faculties and individual teachers create life in school through models of teaching they choose and create. On the other side the teaching learning strategies should focus on the concept attainment.

According to Bruner (1956) the important thing in the process of teaching is the way of one's conceptualization and one's concept attainment. The importance of 'concept attainment' has been justified by many educational psychologists, including Goodnow, Austin and Jerome, S. Bruner. Bruner entitled his work as 'A study of thinking' (1956) which really investigated into the strategies of attaining concepts. According to Bruner, a concept is important because it is the internal mediating variable that accounts for the direction of a person's response to a situation.

1.1. MODELS OF TEACHING

A model of teaching is a plan or patterns that can be used to shape curricula, to design instructional materials and to guide instructions in the classroom and other settings. The most important function of any model of teaching is to improve the instructional effectiveness in an interactive situation of curriculum transaction. (Battacharya, 1994).
Model of teaching is a blueprint of teaching activities, which is needed to generate educative environment within the framework of the task in hand. In other words, models of teaching describe teaching, as it ought to be. In this context "model" does not mean to follow a pattern explicitly but rather to guide one's behaviour by the example of the model. Therefore a "Model of Teaching" consists of guideline for designing educational activities and environments. Joyce and Weil (1972) contend that teaching models are just instructional designs which can be used to shape a curriculum or course. They further described them as the process of specifying and producing particular environmental situations which help the students to interact in such a way that specific change occurs in their behaviour according to Bhattacharya (1994).

The development of models of teaching is an attempt to translate the art of teaching into scientific terms and relationships and trying to give teaching a new language, new models and new direction. Joyce (1972) defines model of teaching as a pattern or a plan, which can be used to shape a curriculum, instructional materials and to guide teachers actions.

Eggen (1979) suggests, "Models are prescriptive teaching strategies designed to accomplish particular instructional goals." The educational environment can be classified into three main domains, the personal, social, and intellectual. Models of teaching can be related to these three domains and any of these can serve as a point of entry to reach learners. The learning of academic contents, as a means to reach learners, results in development of personal and social domains. Another approach seeks to improve the capacity of the learner by influencing the personal domain. Individuals have various potential capacities for responding to the environment, viz., intelligence, creativity, the feeding of adequacy the ability of grow etc. The role of education is the increase these capacities by increasing students'
abilities. The social domain is mother way to reaching the learner. Learners are taught social and economic skills. Learner’s capacity to interact with others is influenced so that the learners to work together with others to identify and solve problems. So the model of teaching plays an essential role in teaching learning process. Models of teaching are designed to impart repertoires, which help students learn information, ideas, academic skills, develop social skills, values and understand themselves and environments. Teaching models are based on the following assumptions:

- Teaching is a means of generating an environment of learning. It involves independent variables.

- The content and skills function as the instruction through which students and teachers interact with one another. Thus it provides an opportunity to develop physical, academic and social efficiency.

- Different types of teaching objectives are achieved by organizing teaching elements in different ways.

- Teaching model provides the learning experiences by creating appropriate environment for real behaviour outcome.

In fact models are designed to reach specific goals. There is no best technique to meet all educational goals. According to Bhattacharya (1994) it is reasonable to assume that no model is universally appropriate, each possesses its own strengths and weaknesses. Joyce and Weil (1972) suggest that, there is no best technique to meet all goals i.e. there is no one best way to teach. The best technique is the one, which will be most effective for reaching a particular goal in a given situation.
Depending upon different goals models achieve, they have been classified into the following four families.

- The Information Processing family
- The Personal Family
- The Social family
- The Behavioural Family

Some of these models of teaching are more appropriate to achieve some objectives than to others. Some are specifically useful to help students' grow in self-awareness and strength of self-concept, some are more appropriate for improving human relations in the class rooms helping students clarify their values. Some others can be used to improve the information processing capacities of students and modify the behaviours of individuals in terms of reducing stress and initiating rehabilitation, and to bring about many more desirable changes in the learners. The Bruner's model of teaching, which is selected for this study comes under the information processing family.

This has to be considered that, each model has been built on the basis of some sound theory as to what actually learning is and how children learn with a view to achieve certain objectives. Therefore, every model has goals, the theoretical assumptions and the underlying principles.

1.2 FUNDAMENTAL ELEMENTS OF TEACHING MODEL

A Model of teaching of consists of some fundamental elements, which describe the operations of the model as a way of communication of the basic procedures involved in implementing any instructional model. Joyce and Weil (1980) have described teaching model on five aspects, namely syntax, social system, principles of reaction, support system and instructional and nurturing effect.
Syntax

The syntax or phasing of the model describes the model or phases in action. Syntax relates to the certain activities of each model, which are arranged in a specified sequence. Each model has specific set of activities and teacher must know the syntax of selected model to work easily in instructional situation.

Social System

The social system describes student and teacher roles and relationships and the kind of norms that are encouraged by each model.

Principles of Reaction

Each model suggests clear guideline as to how to regard the learner and how to respond to the behaviour of learners.

Support System

This refers to the additional requirements beyond the usual human skills, capacities and technical facilities necessary to the operation of a certain model.

Nurturant & Instructional Effect

Each model is developed around some goal. The success of the model is measured by the extent it has attained the goals.

1.3 BRUNER'S CONCEPT ATTAINMENT MODEL OF TEACHING

This model, which belongs to the information processing models, is based on the work of Bruner, Goodnow and Austin’s ideas on concept learning. Their work, "A Study of Thinking" (1956) was the outcome of many years of research into the process by which people acquire concepts. The design of this model, first constructed by Joyce and Weil (1972), is based on their work.
Concept learning represents an important part of the school curriculum at all levels. Students use concepts to help understand and organize their world and teacher and facilitate the process of concept learning (Kauchak and Eggen, 1998).

So, this model has been designed to help students to develop as well as form new concepts. The teacher helps the students to analyse their thinking strategies and methods of concept attainment (Mehra 1995).

Bruner et al. studied the process of thinking under different conditions. And accordingly he developed three variations of the "Concept Attainment Model". These three variations are:

a) Reception Model of Concept Attainment.
b) Selection Model of Concept Attainment.
c) Unorganized materials Model of Concept Attainment.

According to Bruner (1956), teacher should provide problem situations that stimulate students to discover the structure of the subject. Structure refers to the fundamental ideas, relationships, or patterns of the subject (Woolfolk 1987).

Concept Attainment Model requires an array of examples that resemble each other on certain characteristics and differ in the other. The data may be events, people, objects, stories, pictures or any other discriminable units. During the learning, subjects encounter these examples and must find out, whether each instance exemplifies the concept or not. Each instance has potential information about the attributes and attribute values of concept. At any encounter with an example, learner formulates a hypothesis about the concept. Recognizing positive and negative examples
is essential task of concept attainment process. When the students identify
the concept with essential attributes and give additional examples, it shows
that they acquired the concept properly. And then they have to be able to
recognize the concept in the given materials.

Another important aspect of concept attainment is the process of
cracticalization. Students must be familiar with the thinking strategies,
which are used in the process of concept learning. They are asked to explain
and analyse their own strategies of working out of concept. So they describe
their own thinking patterns of acquisition of concept. By this, teacher finds
out which strategy was employed during the process of concept attainment.
These are the all activities of all the three variations of concept attainment
model. The syntax of these variations is some with slight differences in the
set of activities. The important differences between reception and selection
model is in the labelling of examples. In the reception model the instances
are arranged in the label form as an examples and non-examples, but in the
selection model are not designed as "yes" or "no". in this model, students
select the instance to gain information regarding the concept which teacher
has already in mind, and inquire about its status. So, the student control the
sequence of examples and non-examples and label them. In unorganized
materials model, concept is given in the written material and the attributes
of concept are not clear. So, the role of teacher is to facilitate discussion
and ensure that it focuses on the development of concept in the material.

This is worthy to mention that the unorganised materials model is
much more a group discussion and the reception model is more direct in
teaching students the elements of a concept (Mehra, 1995). Here the three
variations of concept attainment model are summarised in the following
tables 1.1 & 1.2.
Table 1.1 Summary Chart: Reception-Oriented Concept Attainment Model

<table>
<thead>
<tr>
<th>Phase One: Presentation of Data and Strategies identification of concept</th>
<th>Phase Two: Testing Attainment of Concept</th>
<th>Phase Three: Analysis of Thinking</th>
</tr>
</thead>
<tbody>
<tr>
<td>Teacher presents labelled examples</td>
<td>Students identify additional unlabeled examples as yes or no.</td>
<td>Students describe thoughts.</td>
</tr>
<tr>
<td>Students compared attributes in positive and negative examples.</td>
<td>Teacher confirms students' hypothesis, names concept and restates definition according to Essential attributes.</td>
<td>Students discuss role of hypothesis and attributes.</td>
</tr>
<tr>
<td>Students generate and test hypothesis.</td>
<td>Students generate examples</td>
<td>Student discuss type and number of hypotheses</td>
</tr>
<tr>
<td>Student state a definition according to the essential attributes</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

SOCIAL SYSTEM

The model has moderate structure. Teacher controls action, but it may develop into free dialogue within phase. Student interactions encouraged. Relatively structured with students assuming more initiative for inductive process as they gain more experience with the model (other concept attainment models are low in structure).

PRINCIPALS OF REACTION

1. Give support but emphasis hypothetical nature of discussion.
2. Help students balance one hypothesis against another.
3. Focus attention on specific features of examples.
4. Assist students in discussing and evaluating their thinking strategies.

SUPPORT SYSTEM

Support consists of carefully selected and organised material and data in the form of discrete units to serve as examples. As students become more sophisticated, they can share in making of date units (as in phase two, "Generating Examples".)
Table 1.2 Selection Model of Concept Attainment

<table>
<thead>
<tr>
<th>Phase One:</th>
<th>Phase Two:</th>
<th>Phase Three:</th>
</tr>
</thead>
<tbody>
<tr>
<td>Presentation of Data and</td>
<td>Testing attainment of the</td>
<td>Analysis of Thinking strategy</td>
</tr>
<tr>
<td>identification of attributes</td>
<td>Concept</td>
<td></td>
</tr>
<tr>
<td>Teacher presents unlabelled</td>
<td>Students identify additional</td>
<td>Students describe thoughts.</td>
</tr>
<tr>
<td>Examples,</td>
<td>unlabelled examples</td>
<td></td>
</tr>
<tr>
<td>Students inquire which</td>
<td>Students generate examples.</td>
<td>Students discuss role of</td>
</tr>
<tr>
<td>examples including their</td>
<td>Teacher confirms hypothesis:</td>
<td>hypothesis and attributes.</td>
</tr>
<tr>
<td>own, are positive ones.</td>
<td>names concept and restates</td>
<td></td>
</tr>
<tr>
<td>Students generate and test</td>
<td>definition according to essential</td>
<td>Students discuss type and</td>
</tr>
<tr>
<td>hypotheses</td>
<td>attributes.</td>
<td>number of hypothesis.</td>
</tr>
</tbody>
</table>

1.3.1 CONCEPTS

1.3.1.1 Definition

Concepts as a basic unit of all types of learning, have been defined in different ways during the time, while yet all the definitions show striking similarities.

Wodruff (1964) says there has been a constant inference that concepts have a significant place in man's thinking processes, but until recently no has one drawn a clear picture of the nature of a concept.

Ausubel (1963) explains concept as a unitary generic idea referring to a class of objects. Corroll (1964) also defines it as an abstraction from a series of experiences, which define a class of objects. Taba (1967) considers the concept as high level abstraction.

According to Bourne (1966) a concept exists whenever two or more distinguishable objects or events have been grouped or classified together, and set apart from other objects on the basis of some common feature or
property characteristic of each. Hunt (1962) provides a simple definition of concept, stating it to be a "label" of set of things that have some thing in common. Klausmeier and Harris (1966) suggest simple definition of concept as the lable of a set of things that have something in common.

Bruner (1956) considers concept as category. According to him, the concept or category is, basically, the rule of grouping a set of attribute values for defining the positive or exemplifying instances of an event.

In the broad sense it can be said that concept is a general idea that stands for a general class and represents the common characteristic of all objects or events of this general class. Concepts as a tool, economises the efforts in thinking.

Kagan (1978) defines concept, which stands for a set of attributes shared by a group of objects or events and he says concept represents what is common among a set of related objects.

Klein (1987) suggests a concept is a symbol, which stands for a class or group of objects or events with common characteristic. He also says, concept enhance the thinking process by incorporating new objects and events into existing categories.

1.3.1.2 Element of Concept

According to Bruner any concept has five elements:

1) Name is the term given to a category.

2) Examples (Positive and Negative) refer to the instances of the concept. All examples, which contain all the criteria attributes of
category, are the positive examples and the negative examples do not have any criteria attributes of concept.

3) Attributes (essential and non-essential) are the common characteristics that cause us to place examples in the same category.

4) Attribute values, refer to the degree to which an attribute is present in any particular example. When the categorization issue terms on matters of degree, we call it an attribute value.

5) Rule, refers to a final statement specifying the essential attribute of a concept. The rules emerge at the end of the process of concept attainment.

1.3.1.3 Structure of a Concept

According to Bruner (1956) three terms (exemplars attribute, attribute value) are used to describe categorizing activity and concept attainment. According to him each term has a special meaning and functions in all forms of conceptual learning, especially concept attainment.

Exemplars are instances of the concept. The concept is learned by the comparing the positive exemplars and constructing them with the negative ones. Klein (1987) considers attribute as one of two main aspects of concept, and says an attribute is any feature of an object or event. Bruner (1956) suggests attribute as "any discriminable feature of an event that is susceptible of some discriminable variation from event to event". The attribute value refers to the degree to which an attribute is present in any particular example.
In the process of classification the different instances are tested and searedned for their features ignoring the others. Any instances can be described in terms of their attributes and their mattribute-value. The combination attributes make one concept differ from another. The distinguishing attributes and their value ranges are called criterial attributes and these are necessary to make difference between the members of different classes.

1.3.1.4 Types of Concepts

The rule, which is one of the two main aspects of concepts (Klein 1987), defines which objects or events are examples of the particular concept. A number of different rules may be used to define the attributes of a concept. So on some instances, the rules can be simple; in other cases, they can be more complex.

Thereby, different types of categories are constructed when different attributes are combined, and the exemplars of particular concept can be recognised by knowing the presence of different range of rules.

Accordingly, Haygood and Bourne (1965) classified the different types of concept as follows:

1) Affirmation - an affirmative rule specifies a particular attribute defines a concept.

2) Negative - a negative rule states that any object or event having a certain attribute is not a member of the concept.

3) Conjunction - this rule defines a concept based on the simultaneous presence of two or more attributes.
4) Disjunction - by this rule, concepts are defined by the presence by one or two or both common attributes, that is an example of the concept can possess either of the two common attributes, or both of them.

5) Conditional - when a concept is defined by this rule, the "if, then" statement can be applied.

6) Bio-conditional / conditional - rule defines a concept using the statement "if and only if".

Klausmeier and Harris (1966) consider that concepts can belong to three classes: the first class is that of concepts that depend on the isolation of some aspect (or set of aspects) of the stimuli which are instances of that concept. The second class is that of concepts that depend on community or agreement of particular responses to the stimuli. The third class is that of concepts which are constructs in general systems of relationships.

But Bruner (1956) has identified three types of concepts namely, conjunctive-disjunctive and Relational.

A "Conjunctive Concept" : is one defined by joint presence of the appropriate value of several attributes.

A "Disjunctive Class" : this class requires the presence of some attributes and absence of others. Disjunctive concepts are often defined by 'either' 'or' characteristics.

A "Relational Concept" : this concept like conjunctive concept has
several attributes, but these bear some kind of relationship to one-another. So this class is defined by a specifiable relationship between defining attributes.

1.3.2 CONCEPT FORMATION AND CONCEPT ATTAINMENT

According to Bruner, Goodnow and Austin (1956), the concept formation refers to the process of establishing a new category, and consists essentially of a process of abstracting the essential common features of a class of objects or events. But Concept attainment refers to the activity of discovering which elements belong to the category and which do not.

According to Bruner, "Attainment refers to the process of finding predictive defining attributes that distinguish exemplars from non exemplars of the class one seeks' to discriminate". In order for the task of concept attainment, the subject must have already formed some concept, so in this sense it may be said that concept formation is the more fundamental process in the concept acquisition. Thereby, when one groups together different instances in a class, one is said to have "formed a concept". When one is able to identify the distinguishing features of a given category, one is said to have "attained a concept."

1.3.3 THE SEQUENTIAL STAGES IN CONCEPT ATTAINMENT

Concept learning involves identification of the properties that characterize a concept as well as those that do not.

According to Bruner, Goodnow and Austin (1956) a concept is learned by testing hypothesis about the correct solution. If the first
hypothesis formed is correct, the individual has learned the concept. However, if the hypothesis is incorrect, another hypothesis will be generated and tested, Hypothesis testing will continue until a correct solution is discovered. Levine's (1966) study also provides support for a hypothesis testing view of concept learning.

As it was mentioned later that different types of concepts like, conjunctive, disjunctive and relational categories, are different types of rules for grouping a set of attribute values for defining the positive instance of a concept. Since different types of concepts have different rules for selecting and combining attributes, different strategies are required for attainment of these concepts.

A strategy can be considered as a systematic procedure used to learn a concept. And according to Bruner (1956) the regularities in decision making during the process of concept attainment can be learned as a "strategies".

Bruner et al. (1956) illustrate that several steps are involved in concept attainment as follows:

1) There is an array of instances to be tested, which leads to the attainment of the concept. The exemplars can be characterized in terms of their attributes and attribute values.

2) A tentative decision or a hypothesis is made on the basis of instance or instance encountered. Before attaining a concept series of decisions are made.
3) The decision is evaluated, this provides information about relevance of attributes and category membership of an instance.

4) The sequence of decisions made for finding out valid attributes for concept attainment has been regarded as "strategy".

5) Any decision about the nature of instance may be regarded of having consequences for the decision-marker.

The sequences of decisions made by the learner during concept attainment (Strategy) embodying certain objectives:

a) To insure that the concept will be attained after the minimum number of encounters with relevant instances.

b) To minimize the wrong categorization prior to attaining a concept.

c) To maximize the information gained from each decision and test of an instance.

d) To keep the cognitive strain involved in the task within the manageable proportions.

e) To regulate the risk of failing to attain the concept within a specified time.

The strategy is inferred from the observed pattern of decisions made by learner during the process of concept attainment. On the basis of the nature of the concept, attributes and attribute values, Bruner and his colleagues have constructed "ideal strategies" on logical grounds.
According to them, *(Bruner et al. 1956)* “an ideal strategy is basically an analytical device used as a yardstick against which to compare the performance of human operators, in the situations we set for them”.

On the process of concept attainment, two methods have been used by psychologists *(Ellis, 1970)* - Method of Reception And Method of Selection. Bruner also has divided the strategies of thinking in the process of concept attainment into two major groups - Reception conditions and selection conditions.

In the method of Reception, each stimulus is shown separately, and problem solvers indicate whether they think the stimulus is an example of the concept. After responding to each stimulus, the subjects are told whether their response was correct. This process continues until subjects have given each correct instance of the concept, an indication that they have certainly learned the concept.

In the method of Selection, the subjects are shown all the stimuli at once and are free to respond to them in any order.

**Bruner et al. (1956)*** identified four major strategies under "selection condition".

1) **Successive Scanning**
2) **Conservative Focusing**
3) **Simultaneous Scanning**
4) **Focus Gambling**

**Successive Scanning** involves testing only one hypothesis at a time.
This is a very simple strategy and when an early hypothesis is correct, a good deal of time may be spent learning the concept.

**Conservative Focusing** entails focusing on the first positive instance of a concept and then choosing on each subsequent trial a stimulus that differs in only one attribute from the focal stimulus. This procedure enables the subject to test the impact of that change from the focal stimulus. The learner continues to select stimuli differing in only one attribute from the focal stimulus until the concept is learned. This strategy requires only one more trial than the number of dimensions.

**Simultaneous Scanning** occurs when several different hypotheses are simultaneously tested on a single trail. This method involves remembering a lot of information and often lead to errors.

**Focus Gambling** is similar to conservative focusing in that the first positive instance becomes the focus of the concept and similar to simultaneous scanning in that more than one hypothesis is tested on each trail. The focus gambling test hypotheses less systematically than conservative focusing does and more trial may be required to identify the concept.

Evaluation of these strategies shows that conservative focusing is the best strategy for all types of conjunctive grouping and simultaneous scanning lies at the lowest level.

1.4 **PIAGET'S DEVELOPMENTAL THEORY**

The most sustained and ambitions attempt at studying children's thinking is that of the swiss-biologist, turned psychologist, Jean Piaget
Piaget believes that human beings develop increasingly more complex levels of thinking in definite stages. Each stage is characterized by possession of certain concepts or intellectual structures which he refers to as schemes. Schemas organize the world in some way, they are programs or strategies that individual use as they interact with the environment. To know an object one must act upon it, either physically or mentally. These physical or mental actions can displace objects or connect, combine, take apart and reassemble them (Piaget, 1970, p. 704). These activities that people perform on objects are known as schemes. Schemes are not particular actions or responses they are what can be repeated & generalized in particular acts. For piaget, the development of intelligence is not the passive unfolding of experience & hearedity. It is the result of increasing ability of the child to coordinate his actions, both physical & mental. These abilities or capabilities are the childs schemes (Piaget and inhelder, 1969).

In the early development of the child, the schemes are physical actions on the objects in his immediate environment. As the child moves towards adolescence these actions become internal mental operations. Like mental arithmetic, older children and adults do not have to move objects physically in order to add and subtract them. We an perform the physical movement by converting the objects to numbers, and we can even do the operations on the numbers without setting them on paper. Although Piaget believes that learning (more properly development) is doing, much of the doing is mental as well as physical.

1.4.1 MAJOR CONCEPTS OF THE DEVELOPMENTAL THEORY:

Assimilation

The child needs environment in order to develop his intelligence. Intellectual assimilation is similar to biological assimilation. Assimilation
is the process of extracting from the environment what is needed for
developing and maintaining schemes. If the schemes are stable or completed,
assimilation operates as a simple digestive process in which the organs of
digestion undergo relatively little change. Assimilation is not exclusively
dependent upon what is available in the environment. It also depends upon
the schemes already available even in the process of changing them. The child's
response to the environment, therefore, is not unlimited - that is, it
is not controlled only by the environment.

Assimilation accounts for the child's ability to act on and understand
something new in terms of what is already familiar (his available schemes).
If the child were limited to assimilation, he would not develop new schemes
new capacities for assimilating new objects and events. To explain how new
schemes develop out of old ones, Piaget has described a second process,
known as accommodation.

**Accommodation:**

Accommodation is changing one's structure to fit the new experience
that occur. Further every encounter with the environment involves a change
in environment so that the person can take it in (assimilation) and it
involves a change in himself as a result of taking it in (accommodation).
These two are simultaneous process. Experience slowly supplies the child
with information that can not be handled adequately through the existing
structures, the schemes gradually accommodate and new ones develop.

Piaget defines accommodation as any change of a scheme by the
elements it assimilates. The progressive modification of schemes through
accommodation allows the child to develop his capabilities beyond that
point of dealing only with the immediate physical environment. The child
can reach a stage where he can solve problems through mental calculations alone.

**Equilibration**

Equilibration is the process of seeking mental balance. At each stage of development the human organism is for a while in a state of equilibrium - that is, the experiences assimilated are compatible with the schemes in operation according to Piaget, equilibrium is a dynamic, not a static, function. It moves development from simple to more complex schemes through the dual action of assimilation and accommodation. Although the simpler schemes and early stages form resting points in the child's intellectual development, these resting points are only temporary states of equilibrium. The child's actions on his environment and his rudimentary understanding of it leaves him unsatisfied. He seeks better control and better answers to his questions. Recurrent frustration and curiosity in the development of children are states of disequilibrium prodding them on to develop more complex schemes and more stable states of equilibrium. Only when children reach the final stage of intellectual development (in their adolescent years) does intelligence take the stable (equilibrated) form we recognize as adult intelligence. Before adult intelligence is achieved children experience imbalances of too much assimilation or too much accommodation. Too much assimilation produces fantasy as when the child uses play objects to represent only what he imagines. Too much accommodation produces mere imitation that simply reproduces the forms and movements of the persons or objects it models.

Equilibration is the process that produces progressive equilibrium between assimilation and accommodation. It is a process of decentralization. Piaget's stance is that the development of the schemes or structures occurs in the same order in all of us and at a relatively predetermined rate - a rate
governed by our physiological maturation. Until the requisite neurological structures are developed, these schemes cannot appear.

1.4.2 PIAGET’S DEVELOPMENTAL STAGES

Piaget classified intellectual development in terms of stages that are characterized by the way the schemes permit the organism to relate to the world. At any given stage, one is able to perform certain kinds of thinking and not others. Piaget’s theory has it that the ways in which we are able to form and handle concepts, changes as we go through childhood into adolescence. The earlier stages, however, lay the basis for future development. The different developmental stages are discussed in the chronological order as under.

Stage - I Sensori Motor: (Approximately birth to two years)

At this stage action is governed by sensations, simple learning occurs, but the child does not think at this stage. According to Piaget these early sensori-motor experiences have profound and probably irreversible effects on his later perceptual & intellective abilities. These early sensori-motor coordinations of the infant which consist of binding together the simple sensory inputs and response productions to reach an external goal, lead gradually to the development of symbolic processes.

Stage - II Pre-Operational Thought: (Approximately 2-7 years)

Roughly between two years of age when sensori-motor development is completed and six years of age when the period concrete operations begin. A major feature of pre-operational thought is that it is egocentric. He has no need to justify his reasoning by logic or to look for any internal consistency in his thoughts. He is unable to consider other features of the situation, he concentrates on a single feature of an object to the neglect of
other important aspects. He attends to superficial features of events, particularly those which attract his attention. Thirdly he concentrates on static states rather than on the dynamic transformations. This reflects a limitation on his ability to handle complex information processing. Finally there is the inability to reverse, a cognitive organization is reversible if one can start a line of thought and, at some point give it up or suspend it and go back to original point. So there is no flexibility in thinking. He is able to use the language at this stage.

**Stage - III Concrete Operations Stage (7-11 years)**

This stage covers the junior school period. The main difference between the pre-operational stage and the concrete operational stage is that the latter is concerned with the stability and integration of cognitive system. The child achieves an organised and cohescent symbolic system of thinking which enables him to anticipate and control his environment. Piaget (1960) defines an operation as an internalized action which can return to its starting point, and which can be integrated with other actions also possessing this feature of reversibility. Operations are "mental acts" which were formerly actions with reversible properties. Piaget calls the operational structures between the ages of 7 and 11 years 'concrete' because their starting point is always some real system of objects and relation that the child perceives; that is the operations, are carried out on concrete objects. The emergence of concrete operations is often a sudden phenomenon in development. Piaget (1960) attributes their emergence to a sudden thawing of intuitive structures which were up to now more rigid, despite their progressive articulation.

**Stage - IV Formal Operations (12-16 Years)**

Between eleven and fifteen or sixteen, the child succeeds in freeing himself from the concrete and the present to the abstract and non-present and future. This is the age of great ideas and the beginning of theories. He
is now capable of handling hypothesis and of reasoning with prepositions removed from the concrete and the present. Formal thinking marks the completion of the child's emancipation from reliance on direct perception and action.

In contrast to the concrete action-oriented thought of the child, the adolescent thinker goes beyond the present and forms theories about everything. This thought is considered 'reflective' since the adolescent reasons on the basis of purely formal assumptions. He can consider hypotheses as either true or false, and work out influences which would follow if the hypotheses were true.

1.5 INTELLIGENCE

Intelligence is one of the central themes of psychology and all disciplines involved in the scientific study of behaviour and the study of human brain. Intelligence is expressed as an ability to guide 'goal directed adapted behaviour'? Intelligence plays an essential role in psychological concepts because of its important educational and social consequences. Concept of intelligence has been defined in various ways.

According to Terman (1921), an individual is intelligent in the proportion that he is able to carry on abstract thinking. Intelligence is the capacity to learn and adjust to relatively new and changing conditions. Wagnon (1937) says, intelligence is the capacity to learn and adjust to relatively new and changing conditions. Intelligence is the ability to adapt to ones surrounding, says Piaget (1952). Other psychologists define intelligence in different ways but the most popular definitions can be summarized as under:

• Intelligence is the ability to deal with abstraction.
• Intelligence is the ability to deal with problems.
• Intelligence is the ability to learn.
• Intelligence is the general ability a person has to respond effectively to the environment.
• Intelligence is the cumulative set of competencies an individual has acquired through interaction with an environment over a period of time.
• Intelligence is whatever one chooses to measure on an intelligence test.

These different definitions have been derived from different viewpoints of intelligence and its components. Some of the important aspects of intelligence (Biological, Cognitive etc.) have been described by Spearman, Thurstone, Piaget, Cattell, Sternberg as given below:

**Historic viewpoints of Intelligence**

In the late 1800, psychologists conceptualized intelligence as consisting of various tasks such as the ability to discriminate the weight of objects, the ability to make auditory discriminations the speed of the subject's response and similar tasks. Galton (1883) was one of the leaders of this orientation.

Aware of the inability of the Galton scales to predict academic achievement, Binet greatly influenced the mental measurement movement in the early 1900 by postulating that intelligence consists of general intellectual ability ('g') to respond effectively towards the environment. Binet (1916) constructed a test consisting of 30 "mental" items arranged in ascending order of difficulty which measured a student's general ability and were designed to predict academic successes and failures.

Spearman (1923), one of the earliest authorities on intelligence, said that each intellectual activity involves a general factor 'g' which
it shares with all intellectual activities and some specific factors which belong to it alone. He assumed that individuals varied in both general intelligence and specific abilities. Through factor analysis, he found that the tests that base most heavily on general intelligence factor were those that are based upon reasoning and judgment. Therefore, he defined this factor as "the capacity to educe relations and correlates" the ability to perceive relationships on connections between things.

According to Thurstone (1938), within a few years after the Binet scales were developed, some psychologists began to question his conceptualizations concerning 'g'. These psychologists were quick to note that "g" did not address the issues related to uneven mental development; some are outstanding on some mental tasks but quite poor on others. Theories were thought to be needed to bridge the gap between the general ability ("g") notion of Binet and the observation that people possess unique constellations of abilities. The early works of Thurstone typify this viewpoint. He eventually identified nine such abilities: space, perceptual speed, numerical facility, verbal comprehension, rate memory induction, word fluency, deduction and general reasoning.

Guilford : Structure of Intellect Model

Guilford (1967) tried to study the intelligence in a systematic way of viewing the nature of intelligence. He said, since the nature of intelligence is not clearly specified, the current measures of intelligence suffer from the same difficulty. His approach makes use of a technique designed to identify and measure the nature of cluster of human intellectual abilities.
Guilford's structure of intellect model postulates 120 specific components of intelligence based on these broad categories.

**Operations**

What one does to the environment, basic psychological processes.

**Contexts**

The nature of the information in the environment, the kind of material or context to which the person responds.

**Products**

The result of an operation upon the contact which produces the find over response.

In each broad category, there are categories that consist of five types of mental operations (evaluation, convergent production, divergent production, memory, cognition), five types of context (visual, auditory, symbolic, semantics, behavioural) and six product (units, classes, relations, systems, transformations, implication). The products are the result of an interaction between the information in the environment and a mental operation upon the information. An ability, thus, is defined as a union of an operation, a context and a product and presumably each individual varies in competence in each of the 150 (5x5x6) discrete abilities.

**Piaget's - Biological approach to intelligence**

Piaget (1964) conceives intelligence as the ability to adapt mentally to new situations or to increasingly complex environment. He views the development of intelligence as part of the more general process of biological development, passing through age-related cognitive stages.
In the sensorimotor stage (0-2 years), much of the basic practical knowledge needed for the foundation of complex thought is formed.

During the pre-operational stage (2-7 years), the beginnings of language and the reconstruction of the sensorimotor experiences take place. Images also develop during this stage. It is during the concrete operational stage of development (7-11 years) that the child begins to solve concrete problems, dealing with objects by using concrete mental operations. As the child involves into the fourth stage of development (formal operations - about 11 years of age in a typical child), the child begins to use hypothetical-deductive reasoning in a systematic fashion. This has to be mentioned that this process occurs with the scope of vide variations in different cultures of environments. Although development is a continuous process of structural changes each stage is characterized by the formal logical structure most useful for describing the child's cognitive functioning during that time span. Each stage is successive, hierarchical and cumulative. So the rate of cognitive development is based on an interaction between the child's maturational state and the nature of the environment. The environment will have very little effect on the child, unless the child is biologically ready to respond to the environment. Piaget's notion of intelligence is very different from the view of intelligence as a collection of specific skills and abilities.

According to him, acts of intelligence is very different from the view of intelligence as a collection of specific skills and abilities.

According to him, acts of intelligence consist of 'adaptation to new situations' and there are two aspects in any act of intelligence, the comprehension of the situation and the invention of a solution.
based on how one comprehends the situation. His concept of intelligence of a system of logical structure has a far more obvious relationship to problem-solving than the tradition view of intelligence. Piaget would allow learners freedom to assimilate and accommodate and to develop schemes at their own pace and would not want the teachers to speed up the cognitive development of pupil.

In an environmental approach, Bruner (1966) has emphasized that the role of culture and specific environment influences in the development of cognitive abilities to a much greater extent. According to Bruner, human beings seek to reconstruct and recategorize the environment based on their learned conceptions of the environment. Evolving through three stages of development (inactive, iconic, and symbolic representation), humans come to learn those strategies for "representing" reality. By Bruner's viewpoint, inactive representation is the ability to represent reality through motor responses. An iconic representation is the ability to represent reality through motor responses. An iconic representation is the ability to represent images based upon the environment, and symbolic representation is the ability to represent reality through the use of symbols (either language or pictorial symbols). Only after child can represent reality adequately through these modes does the child learn to manipulate the representations to solve complex cognitive problems.

The task for educator's operating within a Brunerian frame of reference is to convert what is known into a form that can be mastered by a child at any level of development Bruner's ideas have had a particularly strong impact on discovery learning strategies, theories of instruction, the modern mathematics curriculum, and the role of language in cognitive development.
Cognitive Theories of Intelligence

These theories of intelligence try to analyze and describe intelligence in terms of certain fundamental cognitive processes. These theories can be considered as new view of looking at intelligence which has emerged in recent years on the basis of research on cognitive development and information processing. As Maharaj Singh (1997) says, the cognitive psychologists are trying to relate simple cognitive components to IQ scores. These cognitive components are based upon information processing model of cognition. According to the theory of information processing the more intelligent person is likely to receive, store and retrieve in an effective manner.

Cattell (1965), Horn (1978), Jensen (1969), Campion and Brown (1978) and Strenberg's (1985) ideas, can be classified under these theories. Therefore, here, Cattell and Strenberg theories, briefly, are discussed.

Cattell and Horne's Theory of Intelligence: They proposed a theory of intelligence by distinguishing between two types of intelligence, i.e. "fluid intelligence and crystallized intelligence."

Fluid intelligence is considered to be the mental capacity of an individual, which is required for learning and problem solving. It is dependent on neurological development and is relatively free from the influence of education and culture. This type of intelligence is put to use when facing new and strange situation requiring adoption, comprehension, reasoning, problem solving and identifying relationships.

Crystallized Intelligence is not a function of one's neurological development and therefore it is specially learned and dependent on
education and culture. It involves one's acquired fund of general information consisting of knowledge and skills essential for performing different tasks in one's day-to-day life.

**Sternberg's (1985) Information Processing of Intelligence:**
The research on cognitive development and information processing for understanding the intelligence has emerged as a new way of looking at intelligence. This new approach describes the mental processes that are involved in intelligent performance (i.e. the process that people use to solve problems in intelligence tests and in life) in terms of components. A component is an elementary information process that operates on internal representations of objects or symbols. Components are classified by the functions they serve (meta-components perform higher order planning, strategy selection and monitoring; performance components execute the strategies selected and knowledge acquisition components serve to join new knowledge) and by how general they are, specific components are necessary for one kind of task but not for others. On the other hand, general components may be necessary in almost every cognitive task. Meta-components are an example of general components and these help to explain the persistent correlation among all types of mental tests. People who are effective in selecting good problem solving strategies or in monitoring progress and moving to a new approach when the first one fails are more likely to be successful on all types of tests. Therefore, meta components may be the modern day version of Spearman's "g" (Woolfolk, 1987).

Despite the basic conceptual controversy over intelligence, there is a consensus among psychologists on two points. First, in terms of
measurement of intelligence, the Galton idea that intellectual ability manifests itself in simple discrimination functioning has been abandoned for the time being in favour of the Binet notion that it reflects itself in more complex functioning. Second, intelligence tests are seen by most as moderately good predictors of school achievement. That is why despite the various limitations of intelligence tests i.e. IQ scores of individuals tested over the years rarely stay the same. Low test score may lead to unfortunate self-fulfilling prophecy reactions. Test scores sometimes cause pupils to be improperly classified and educated, it is the only means of measuring intelligence.

Experts agree that IQ testing should be used to diagnose strengths and weakness of individual pupils in order to establish the most effective learning environment. The standard progressive matrices prepared by Raven (1960) were employed to assess a pupil's ability. The scale consists of 60 problems divided into five sets of 12 (A,B,C,D and E). In each set the first problem is as nearly as possible self-evident. The problems that follow become progressively more difficult. The scale is intended to cover the whole range of intellectual development.

1.6 COGNITIVE STYLES

Cognitive style is a broad dimension of individual differences that extends across both perceptual and intellectual activities. Cognition covers various modes of knowing, perceiving, imagining, remembering, conceiving, judging and reasoning. The term style is used because what is at issue is the characteristic approach the individual brings with him to a wide range of situations. Since the approach encompasses both his perceptual and intellectual activities, it is called his 'cognitive style'.
Cognitive styles refer to the modes an individual employs in perceiving, organizing and labeling various dimensions of the environment. Thus, it may be said cognitive styles appear to reflect consistencies in the manner or form of cognition, as distinct from the context of cognition on the level of cognitive skill displayed. Kagan (1964) conceives cognitive style as the preferred way of a specific class of conceptual responses, whereas for Shuell (1981), cognitive style refers to the "preferred ways that different individuals have for processing and organizing information and for responding to environmental stimuli".

Cognitive style reflect aspects of personality as well as aspects of cognition. Thus although they function to control and regulate the course of information-processing and are typically measure as response consistencies on cognitive tasks, their operation may be in the service of underlying personality traits for such dynamic themes as anxiety over error, expectancy of success and failure, and vulnerability to distraction which are central to many of the measures utilized in their assessment.

It has been observed that certain individuals tend to respond very quickly in most situations (impulsive cognitive style); others are more reflective and slower to respond (reflective cognitive style), even though both types of individuals are equally knowledgeable about the task at hand. Cognitive styles thus suggest that individuals approach the same task in different ways but these variables don't reflect levels of intelligence or patterns of general abilities. They are often described as falling on the border line between mental abilities and personality traits (Shuell, 1981); are styles of 'thinking' and

- 35 -
thus influence and are, in turn, influenced by cognitive abilities (Broadzinsky, 1982).

Although defined as modes of information processing, cognitive styles are not simple habits in the technical sense of learning theory. They are not directly responsive to principles of acquisition and extinction. They develop slowly and do not appear to be easily modified by specific tuition or training. Research reveals that cognitive styles exhibit stability and pervasiveness across diverse spheres of behavior; that though they entail generalized habits of information processing, they are intimately interwoven with affective, temperamental and motivational structures as a part of the total personality. Thus it may be said that the manifestation of a core personality structure in cognition is cognitive style.

1.6.1 CHARACTERISTICS OF COGNITIVE STYLES

The essential characteristics of cognitive styles in general have been given by Witkin et al. (1977). According to them cognitive style are concerned with the form rather than the content of cognitive activity.

- These refer to individual differences as to how we perceive, think, solve problems, learn, relate to others.
- They are pervasive dimensions, that cut across the boundaries traditionally used in compartmentalizing the human psyche and so help to restore the psyche to its proper status as a holistic entity.
- They are stable over time; it is not that they are unchangeable, some may be rather easily altered. This stability makes stylistic dimensions particularly useful in long-range guidance and counseling.
With regard to value judgements, cognitive styles are bipolar and range from one extreme to the opposite extreme wherein each end of the dimension has different implications for cognitive functioning. Each pole, thus, has adaptive value under specified circumstances and may be judged positively in relation to those circumstances.

The influence of above characteristics extends to almost all human activities that implicate cognition, including social and interpersonal functioning.

1.6.2 COGNITIVE STYLES DIFFER FROM INTELLECTUAL ABILITIES

The foregoing discussion makes it clear that cognitive styles differ from intellectual abilities in a number of ways. Whereas ability dimensions refer to the content of cognition or the question of what (what kind of information is being processed by what operation in what form), cognitive styles bear on the question of 'how' (on the manner in which behavior occurs). While the concept of ability implies the measurement of capacities in terms of maximal performance, that of cognitive styles implies the measurement of preferred modes of operation in terms of typical performance. Whereas abilities are generally regard as being unipolar cognitive styles are bipolar.

Another way in which they differ from intellectual abilities is in the values usually placed upon them. While high quantitative aptitude may be valued over low quantitative aptitude, we would hardly have the same general preference for impulsive as opposed to reflective
cognitive dimension. Neither end of cognitive styles dimension is uniformly more adaptive. Rather their adaptiveness depends upon the nature of the situation and upon the cognitive requirements of the task at hand. This has important implications for education since it serves to establish that cognitive styles are usually not considered as outcome objectives of educational or training programmes except possibly for younger students. Rather cognitive styles are important to consider as input variables that might moderate the operation and effectiveness of educational/training programmes or interact with programme components to produce differential results. Each of the individual cognitive dimensions has been found to correlate with certain intellectual tasks and the ability to learn and perform in school. Of the many listed cognitive styles identified by researchers over the years, a few prominent one that are used to prepare cognitive profiles of individuals are field dependence-independence, reflectiveness versus impulsivity, leveling versus sharpening, tolerance versus intolerance, focus-nonfocus, broad-narrow and fixity-mobility. Out of these, field-dependence/independence cognitive style has been the most widely researched and used.

As with field-dependence, impulsive and reflective cognitive styles are not highly related to intelligence within the normal range. However, as children grow older, they tend to become more and more reflective, and for school-age children, being more reflective does seem to improve performance on certain school tasks (Messer, 1976). Also for reflective children the chances of failing in one of the early grades are much less than for impulsive children (Messer, 1976). Impulsive students can be taught to be reflective by means of self-instructional training (Meichenbaum, 1977) or by scanning strategies.
1.6.3 FIELD DEPENDENCE-INDEPENDENCE COGNITIVE STYLE

Research evidence accumulating on the field-dependence independence cognitive styles ever since the year 1952, when it was first identified by Witkin et al. (1954), suggests that a cognitive style approach may be profitably applied to a variety of educational issues (Witkin et al, 1954/1972; Witking, 1976). Work on cognitive styles of field dependence-independence has resulted in the formulation of various concepts and methods and these are increasingly being applied to research on problems of education. The construct has been related to intellectual functioning and to hemisperic functioning and these two variables have been related to each other. Research evidence reveals that individuals demonstrate pervasive self-consistency in cognitive functioning and so that division into the perceptual and intellectual is hardly of value in the study of cognitive styles. Measures of field dependence have been reported to be significantly related to total standard intelligence test scores and this significant relationship is carried largely by those portions of intelligence tests which require analytical functioning. Thus the relation is based on the expression of a particular style of field approach in both.

The concept of field dependence emerged initially from the studies by Witkin et al (1954) on perception of the upright in space. Studies of RAT (room-adjustment test), BAT (body-adjustment test), and RFT (rod-and-frame test) performance demonstrated striking individual differences in the extent to which location of the perceived upright is determined with reference to the axes of the prevailing visual field. Through these various tasks, they showed that individuals differed widely in their field dependence or the extent to which their perception of the upright is influenced by the surrounding visual field.
Witkin et al (1954) could gather enough evidence to indicate that field-dependence is a relatively stable, consistent trait, having a certain amount of generality. Their tests demonstrated that an individual tends to be consistent in his perceptual functioning from test to test. Thus, the person who is unable to maintain the 'separateness' of his body from the surrounding field in the BAT cannot also determine the position of the rod independently of the titled frame in RFT. A little later, they found significant correlations between these orientation test and EFT (embedded figures test) which, measures field dependence in a purely visual paper and pencil situation. Thus test features the ability to perceive an item independently of its context and does not involve body position. With the accumulation of research data, field dependence soon came to be regarded as the perceptual component of a broader personality dimension designated as global versus articulated cognitive style or psychological differentiation (Witkin, Dyk, Faison, Goodenough and Karp, 1962). Evidence indicates that this cognitive style exhibits considerable stability through childhood and early adulthood and is related to a number of personality variables such as leadership (Weissenberg and Gruenfeld, 1966) and social conformity (Witkin et al, 1974) Field dependence-independence refers to a consistent made of approaching the environmental in analytical as against global terms. It entails a tendency to experience items as discrete from their backgrounds, and reflects ability to overcome the influence of an embedding context.

Accumulating research data points out that field dependence-independence extends into psychological domains beyond cognition (Witkin, 1976). Such individuals differ from each other in important personal characteristics and in interpersonal relations. Field dependent
individuals are more influenced by the attitude of an authority figure or peer group but the field independent individuals are less responsive to the human content of the environment.

Experts are of the considered view that cognitive characteristics for both field dependence-independence must be considered in making predictions and interpreting findings on how cognitive style figures in various aspects of the educational process since these styles show themselves in perception, they are readily accessible to observation and assessment by controlled laboratory techniques. Because scores from any test of field dependence/independence form a continuous distribution, these labels reflect a tendency in varying degrees of strength, towards one mode of perception or the other.

Although teachers cannot determine all the variations in student's cognitive styles, they should be aware that students approach problems and process information in different ways. Woolfolk (1987) observes that some may need help in learning to pick out important features and to ignore irrelevant details. This does not mean that they are less intelligent but simply that they tend to perceive patterns as wholes and have trouble analyzing. They may seem lost in less structured situations and need clear, step-by-step instructions. They may work best in social situations and be less motivated by individual contracts or projects. Other students may be great at organizing but less sensitive to the feelings of others and not as effective in social situations. Learning styles of field-dependent and field-independent individuals are given in table.
### Learning Styles

<table>
<thead>
<tr>
<th>Field-Dependent</th>
<th>Field Independent</th>
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<tbody>
<tr>
<td>perceives globally experiences in a global fashion, adheres to structures as given makes broad general distinctions among concepts, sees relationships social orientation learns material with social content best. attends best to material relevant to own experience requires externally defined goals and reinforcements needs organization provided. more affected by criticism uses spectator approach for concept attainment.</td>
<td>perceives analytically experiences in an articulated fashion, imposes structure or restrictions makes specific concept distinctions, little overlap impersonal orientation learns social material only as an intentional task interested in new concepts for their own sake has self-defined goals and reinforcements can self-structure situations less affected by criticism uses hypothesis-testing approach to attain concepts.</td>
</tr>
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### Teaching Styles

<table>
<thead>
<tr>
<th>Field Dependent</th>
<th>Field Independent</th>
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<tbody>
<tr>
<td>prefers teaching situations that allow interaction and discussion with students uses questions to check on student learning following instruction. uses student-centered activities viewed by students as teaching facts provides less feedback, avoids negative evaluation strong in establishing a warm and personal learning environment.</td>
<td>Prefers impersonal teaching situations such as lectures. Emphasizes cognitive aspect of instruction. uses questions to introduce topics and following student answers. uses a teacher-organized learning situation. viewed by students as encouraging to apply principles gives corrective feedback: uses negative evaluation strong in organizing and guiding student learning.</td>
</tr>
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How to Motivate Students

<table>
<thead>
<tr>
<th>Field Dependent</th>
<th>Field Independent</th>
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<tbody>
<tr>
<td>through verbal praise</td>
<td>through grades</td>
</tr>
<tr>
<td>through helping the teacher</td>
<td>through competition</td>
</tr>
<tr>
<td>through external rewards</td>
<td>through choice of activities, personal</td>
</tr>
<tr>
<td>(stars, stickers, prizes)</td>
<td>goal chart</td>
</tr>
<tr>
<td>through showing the task's value</td>
<td>through showing how the task is</td>
</tr>
<tr>
<td>to other people.</td>
<td>useful to them.</td>
</tr>
<tr>
<td>through providing outlines and</td>
<td>through freedom to design their own</td>
</tr>
<tr>
<td>structure</td>
<td>structure.</td>
</tr>
</tbody>
</table>

What Teachers Expect From an Administrator

<table>
<thead>
<tr>
<th>Field Dependent</th>
<th>Field Independent</th>
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</thead>
<tbody>
<tr>
<td>to give warmth, personal interest.</td>
<td>to focus to task</td>
</tr>
<tr>
<td>support to provide guidance.</td>
<td>to allow independence and flexibility</td>
</tr>
<tr>
<td>modeling.</td>
<td>in teaching approach.</td>
</tr>
<tr>
<td>to seek teachers' opinions in making</td>
<td>to make decisions based on analysis</td>
</tr>
<tr>
<td>divisions to &quot;practice what they</td>
<td>of</td>
</tr>
<tr>
<td>preach&quot;</td>
<td>problem to be knowledgeable about</td>
</tr>
<tr>
<td></td>
<td>curriculum and administration.</td>
</tr>
<tr>
<td>to have an &quot;open door&quot;</td>
<td>to maintain professional distance.</td>
</tr>
</tbody>
</table>

1.7 REVIEW OF RELATED STUDIES

The series of related studies is very important aspect in the planning of a new study. The review of related studies helps us to know what others have tried to find out and what problems remain to be solved. It helps researchers to eliminate the duplication of what has been already done and it provides useful hypotheses and helpful suggestions for further investigations. Here the review of the related studies is given according to teaching strategies, cognitive styles and piaget's developmental stages in relation to achievement.
1.7.1 Teaching Strategies and Achievement

Roy (1986) conducted a study on effectiveness of strategies of training concept attainment model in pre-service teacher trainees and it was concluded that there were no significant differences in mean gain scores of samples.

Ponick (1986) studied instructional design that facilitates concept learning and made focus on manipulating visual cognitive process affecting concept attainment by the learner. It was found that there were no significant differences among the treatment group.

Panda (1986) conducted a comparative study on the effect of advance organizer and set induction on learning and found that the difference between the mean achievement of pupils through advance organizers and set induction and traditional method are significant.

Dutt (1987) studied the effect of Bruner's strategies of problem solving ability of high school students. It was observed that the focusing strategy were superior to scanning strategy of problem solving.

Sushma (1987) found that biological inquiry model was more effective than conventional teaching and concept attainment model was more effective than biological inquiry model and no significant differences were found between the gain scores of attitude with Biological science inquiry model based teaching and conventional teaching.

Baveja (1988) studied the information processing models of teaching in schools of India. She found that the concept Attainment model and Inductive Thinking model were superior to the Traditional Method in terms of concept attainment and retention.
Kaur (1988) compared the effectiveness of Bruner Model and conventional method for teaching concepts in mathematics. The results of the study indicated that there was no significant difference in the efficacy of Bruner's concept Attainment Model and conventional method of teaching.

Sood Kamla (1988) compared Advance Organizer model and reception strategy of concept attainment model for acquisition of language concepts and found concept attainment strategy is more effective for teaching Hindi Concepts.

Kanta (1989) examined the effectiveness of concept Attainment model in teaching chemistry concepts. She found that teaching strategies helped the students in attaining and learning chemistry concepts.

Bhaveja B. (1989 a, 1989 b) in her two studies compared effectiveness of concept Attainment model with Taba's Inductive thinking model in regard to the concept learning in biology and also analysed thinking strategies used by the learners.

Chaudhari and Vaidya (1990) studied the effect of Advance Organizer and concept Attainment model. They found that concept Attainment model produced significantly better effects than either Advance organizer model or Traditional method in the competency of student - teachers.

Gautam and Pachauri (1990) conducted a study on thinking model and Traditional method of teaching physics to class-VIII students and found that Inductive Thinking Model was highly effective in class room teaching.
Goel (1990) studied the effect of teaching through concept attainment model on acquisition of language concepts. It was concluded that both the models i.e. concept attainment model and conventional model of teaching were found to be equally effective in terms of achievement in Hindi language concepts.

Singh D.K. (1990) compared CAM with ITM and found both the models were equally effective in teaching of physical science to class-IX pupils.

Swrup S. Budhisagar and Rajoria R. (1990) studied the influence of study habits and instructional material with and without Advance Organizers that their was significant interactional effect between treatment and concentration and treatment and support on achievement of students.

Kaur R.P.(1991) found that for teaching of concepts in economics both the models Advance Organizer and concept Attainment are effective and Advance organizer is more effective than concept attainment model.

Behl Vinay (1992) studied the effects of concept attainment model and computer model on acquisition of concept in mathematics and found that computer model of teaching was superior to concept attainment model.

Ruangruchira (1992) studied the effects of Advance Organizer on students achievement in general Chemistry. The results indicated that the Advance Organizer group performed significantly better than the control group.

Sandhu Kamaljeet (1992) conducted a study on the effectiveness of advance organizer model for acquisition of language concepts and found that both the strategies were equally effective in acquisition of concepts.
Kochhar S. Rajiv (1993) studied the effectiveness of Hilda Taba's Inductive thinking model and Bruner's concept attainment model of teaching in learning of concepts in science and found that both strategies were equally good in learning of concepts in science.

Singh (1993) studied effect of mastery learning strategies on acquisition of algebraic concepts and found that mastery learning strategy is superior in teaching algebraic concepts to IX class students.

Chopra Seema (1994) studied that both models i.e. concept attainment model and conventional models are equally good in learning of concepts in English language.

Singh (1994) found that Inductive thinking model was more effective than traditional method in terms of achievement in Economics.

Gupta Sushma (1995) concluded that any of three information processing models of teaching employed for teaching science concepts, concept attainment model and inductive thinking model were found to be superior to advance organiser model of teaching for teaching the concepts of science to class-IX students.

Naik (1997) found Inductive thinking model effective in increasing reasoning ability and achievement and retention in mathematics as compared to the traditional method of teaching.

Mehra and Sangwan (1998) concluded that AOM of teaching was more effective than traditional classroom teaching in the teaching of Biology at school level.
Bhushan and Mehar (1999) found AOM as effective as traditional method of teaching in high school geography.

Vandana Mehra and Khare Sharad Bala (2002) studied the effect of ITM, AOM and conventional method of teaching on achievement of B.Ed. students in educational technology and found that ITM was effective as compared to conventional method and AO does not facilitate learning.

1.7.2 Cognitive Styles and achievement

Mrosla (1984) suggested that low achievement mathematics students were more field-dependent than high achievement mathematics students and he also found that there was a significant interaction on the achievement variable and sex variable with respect to field dependence dimension.

Peterson (1984) concluded that field-independent students performed better in mathematics than field-dependent students while the field-dependent students were better at learning material.

Randolph (1984) investigated the relationships among cognitive style, achievement in science, selected personality and the sex variables and found significant correlations among field-independence and science achievement. No significant differences were found between the performance of males and females on the science achievement test.

Dugger (1985) studied the effects of two contrasting instructional approaches representing the field-dependence-independence cognitive dimension on the mathematical problem solving performance and found statistical differences in the mathematical problem solving of the two
treatment groups, receiving field-dependent and field-independent instruction, over the control group. Therefore, the conclusions supported the assumption that the field dependence - independence cognitive dimension applied to teaching improved the students performance in mathematical problem solving.

Nelson (1986) studied the effects of field - independence - dependence cognitive style on achievement in a telecourse and found no significant differences between the attitude of field - dependent/independent students enrolled in a telecourse. Students with a field-independent learning style scored higher grades than students with a field-dependent style. There was no association between field - independent/dependent and course completion.

Dutt (1987) concluded that intelligence of the solver significantly affected the problem solving ability irrespective of strategies of training. Cognitive style of learner was also found to be significantly contributing to the variance of problem solving ability scores, thereby showing that cognitive style affected problem solving ability irrespective of training strategies. The group having field independent cognitive style scored higher mean than field dependent group on problem solving ability test.

Arrington (1989) studied the relationship between cognitive style and problem solving in eights grade students. It was revealed that problem solving was positively correlated to cognitive style and concluded that field-independent subjects were more proficient problem solvers than field-dependent subjects.

Study of Gill T.K.(1989) resulted in (1) high intelligent subjects scored higher on originality than low intelligent subjects irrespective of
training strategies. (2) The group having field independent cognitive style scored higher on originality than field dependent group on creative problem solving skill test.

Rogers (1990) found that subjects who were more field independent tended to demonstrate more sophisticated programming strategies than field dependent subject.

Budhdev, Parvina V (1990) studied the effect of cognitive variables on achievement in mathematics of secondary school students and stated that from the beginning of formal education great emphasis is placed on academic achievement. Variable which affect the academic achievement can be identified as cognitive and non cognitive.

Lata Manju (1990) in her investigation studied the relationship of cognitive style with scholastic achievement and intelligence and found that intelligence play a significant role in every sphere of life including learning.

Roso, Marc Honorato (1991) found that cognitive styles were manifested in certain aspects of reading comprehension of narrative and expiratory prose is likely to differ remarkably as a function of cognitive styles.

Bal Nimrat (1992) studied the effect of Reception learning strategy on language achievement in relation to cognitive styles and found that variable of cognitive style had a non-significant affect on acquisition.

Gautam Gargi (1992) conducted an investigation on the effect of inquiry training model on achievement of adolescents studying economics
in relation to their cognitive style and found that interaction between teaching models and different levels of cognitive style was found to be insignificant.

Sandhu (1992) found that the group having field independent cognitive style scored higher mean than field dependent group in achievement test.

Ganihar (1993) in her study on a sample of 200 students of class-IX of four schools of Dharwad city found that there was significant relationship between cognitive style and academic achievement in social studies, language, mathematics, science and English.

Krank (1993) found no statistically significant predictive power for cognitive style or treatment condition. 'Pre-service teachers' cognitive styles did not significantly contribute to enhanced critical thinking abilities.

Custer Thomas Alan (1994) indicated that students with strong independent learning styles showed significantly higher chemistry achievement and greater achievement gains.

Devinder Kumar (1995) studied effectiveness of mastery learning strategies on achievement in economics in relation to cognitive style and found that field dependent and field independent students did not differ significantly on the achievement of economics concepts.

Mehar Ram (1997) studied the role of advance organizer model in learning and retention with respect of cognitive style and learning types.
in geography and found that there is no difference in the gain mean scores yielded by the subjects having field dependent style and field independent cognitive styles.

1.7.3 Piaget's Developmental Stages and Achievement

The language development pattern of 65 children using piaget's test of conservation of amount and Sinclair de Zwart's test of linguistic ability was examined by Ghuman and Girling (1974). The results indicated that syntactical structures are closely linked with the operational level of thinking and the two are possibly interdependent.

Winton (1975) studied the role of language in the development of child's understanding of number concepts involving 120 subjects aged four and a half to seven years. The significant correlations were found between the mousers of language abilities of children and their performance on both (nonverbal & verbal) tests of number conservation. School experience was found to be a significant factor for the performance of subjects on the verbal test.

Gillet (1977) conducted study on a sample of third grade children to determine of Piagetian classification ability and performance on certain standardized reading comprehension test items were related and to determine if such a relationship was evidenced when world recognition ability was controlled. The result indicated that there were significant differences between the classification groups in achievement on classification items in the silent reading setting when word recognition was controlled and on all items in the listening setting. General classifiers had significant higher achievement on these measures than intermediate and prior classifiers.
Prawat and Jones (1977) conducted a longitudinal study of language development on 68 first grade children, who were at different levels of cognitive development and their results supported the view that cognitive development is an important factor in language development.

Asha Behl (1982) studied differential predictive efficiency of creativity and intelligence for achievement of two Piagetian stages of concrete thinking and formal thinking and found that creativity and intelligence are interrelated models of same intellectual functioning yet at the same time in factor structure they are distinguishable from each other. During the developmental process from concrete to formal operational stage, their destructiveness increases.

Gakhar and Behal (1980) found higher relationship between figural creativity and intelligence at concrete stage but the relationship decreases as the formal stage starts.

Gakhar and Jagdip (1980) found non-significant positive correlation at the age 9+, positive significant relationship at the age 10+, whereas negative significant relationship at the stage 11+ between figural creativity and scores of total Piagetian tasks as measured through production, conservation, correspondence and classification. As age increased from 9+ to 10+ years the relationship between Piagetian tasks and figural creativity variables positively increased but from 10+ to 11+ years they become negatively significant because of the shift from concrete to formal operational thought.

Mwamwenda (1990) investigated the performance of 658, II and III grade Botswana children (aged 6-12 years) on Piagetian class inclusion, conservation and transitive inference tasks by using judgement versus
judgement plus explanation as the criterion. It was found that the use of judgement only as a criterion led to a statistically significant proportion of children passing the piagetion tasks, whereas when assessed on the basis of both judgements and explanations on Piagetian tasks, both linguistic and cultural problems inhibited the successful performance of the children.

Kurey (1991) studied the teacher and learning cycle approaches to performance in high school, chemistry topics by students tests for Piagetian cognitive development. The subjects of this study were 110, tenth, eleventh and twelveth grade students in suburban private high school. The results of the study indicated a 44% beneficial effect in favour of the learning cycle approach.

Gurinderjit K.Bal (1992) studied effect of audio-visual instructions on acquisition of concepts at Piaget's concrete and formal operation stages and found that out of three modes of instructions used for teaching concepts in the subject of social studies. Audio visual instructions with verbalization proved to be the most effective method than other two modes of instructions at the concrete operation stages.

Kyhl (1994) in a study on 104 subjects (8 to 18 years that is grade III to XII) reported that the order of the attainment of the classification structures is class inclusion, vicariance, classes in hierarchy and rectangular arrays. Significant relationship between task performance and grade level and no significant relationship between task performance and gender were also reported in the study.

Kimmins (1994) conducted a study on children ages 4 to 7 years to find out the relationship between young children's understanding of randomness and piagetian developmental level. It was observed that some
children as young as it could distinguish between a determine and a fortuitous outcome when the criteria for understanding was judgement as opposed to judgement plus explanation. No children age 4 and few children ages 5,6,7 years provide adequate explanations.

**Kaur Jagdip (1996)** conducted her investigation on the development of piagetian concrete operational thinking and ability to verbalize reasoning as related to creative performance and found that hypothesis the development of conservation, serration and classification abilities of piagetian concrete operational thinking takes place from grade-III through VI representing age group of 8+ through 11+ years stands accepted.

**Malathi Rajgopalan (1996)** developed path model for formal operational thinking and found that the potential ability measured in terms of IQ has the highest influence on the development of formal reasoning.

### 1.8 EMERGENCE OF THE PROBLEM

There is no single or best method of teaching but alternative approaches to teaching based on instructional goals, type of content and learner characteristics. As teachers we have to always keep in mind that students are an important part of the teaching - learning process and that method of teaching employed makes a lot of difference to what is learned and how it is learned.

From the appraisal of research studies in teaching methods and strategies namely, **Sushma (1987), Dutt Sunil (1989), Samriti (1987), Sood Kamla (1989), Goel Madhvi (1990), Kochhar S. Rajiv (1990), Puja Sawhney (1993), Sushma Gupta (1995)**. It has been found that models of teaching are effective in teaching - learning process. But very few studies have been conducted at piaget's different levels of intellectual developmental
stages by taking into account the cognitive styles and intelligence. Also, very few research support have been found in the implications of concept attainment models and its strategies. So the present study intends to investigate the effectiveness of concept attainment model at concrete operations and formal operations stages with gender, intelligence and cognitive styles, as variables.

1.9 STATEMENT OF THE PROBLEM

The problem was stated as follows:

"Effectiveness of teaching strategies in the acquisition of science concepts in relation to intelligence, cognitive styles and gender differences."

1.10. OBJECTIVES OF THE STUDY

The following were the objectives of the study:

- To compare the different teaching strategies of concept attainment model over the traditional method in teaching of science concepts.
- To see the effectiveness of the strategies of concept attainment model in teaching science concepts to concrete operations stage (7-11 years age group).
- To see the effectiveness of the strategies of concept attainment in teaching science concepts to formal operations stage (12 years onwards).
- To see the effect of cognitive style on acquisition of science concepts irrespective of strategy of teaching.
- To see the effect of intelligence on acquisition of science concepts irrespective of strategy of teaching.
To see the effect of gender on acquisition of science concepts irrespective of strategy of teaching.

To see the international effect of cognitive styles and intelligence on acquisition of science concepts.

To see the interactional effect of cognitive styles and gender difference on acquisition of science concepts.

To see the intellactual effects of cognitive styles and teaching strategies on acquisition of science concepts.

To see the intellactual effects of Teaching Strategies and intelligence on acquisition of science concepts.

1.11. HYPOTHESES

Main effects

- There will be significant mean differences in achievement of pupils taught through different teaching strategies at concrete operations stage.
- There will be significant mean differences in achievement of pupils taught through different strategies at formal operations stage.
- There will be significant mean differences between male and female pupils in terms of acquisition of science concepts.

The following will be the interactional hypotheses for both the stages of development, namely, concrete operations and formal operations:

First Order interactions:

- There will be significant interaction between type of strategies and level of intelligence.
- There will be significant interaction between type of strategies and male and female pupils.
- There will be significant interaction between type of strategies and cognitive styles.
- There will be significant interaction between levels of intelligence and male and female pupils.
- There will be significant interaction between level of intelligence and cognitive styles.
- There will be significant interaction between cognitive styles and male and female pupils.

**Second Order interactions**:
- There will be significant interaction among levels of intelligence, gender and cognitive styles.