CHAPTER - I
INTRODUCTION
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Research has identified a number of links between effective teaching and improved learning. Public interest has focused as perhaps never before on the important role that school serve in educating students for a technological world. Cognitive psychologists continue to unravel the mysteries of learning and its retention through the use of research focusing on information processing strategies of learner. A good teacher always tries to teach his/her students with best technique. Argument over the question about the best way to teach has absorbed educator’s energies since the beginning of the formal education. Attempts to answer this question have focused on authoritarian versus democratic techniques (Anderson, 1959), discovery-oriented versus expository approaches (Keislar and Schulman, 1966), teacher versus student-centeredness (Dunkin & Biddle, 1974). Research on effective teaching has provided us models of teaching and documented their effectiveness in the process of education. Models are prescriptive teaching strategies designed to accomplish particular instructional goals. They are prescriptive in that the teacher’s responsibilities during the planning, implementing and evaluating stages are clearly defined. The students are also important factor influencing the choice of a teaching method as students respond differently to various instructional strategies (Corno & Snow, 1986).

Education is the most cogent instrument in the progress of any nation. Hence, the quality of education has to be improved for faster all-round development. It is universally acknowledged that any attempt at the improvement in the quality of education ultimately depends on the quality of instruction imparted in the classrooms. The purpose of education is to manage students' learning and the value of any technology used in it. In a wider perspective, technology today seems to hold out more benefits than ever before. Educational technology has exhibited a great amount of promise and potential in facilitating teaching and learning. It can help further in the development of need based courses, organization of content units, development of educational programs and procedure of their monitoring and feedback.
1.1 TEACHING

Teaching is a complex activity carried on in the complex situation of the school by complex organisms—human beings (teachers) directed towards more complex organisms (students) who are constantly undergoing complex changes. In the present fast-growing age, lot of information has to be collected from multifarious sources, integrated and then processed in a gainful manner not only within self but to the next generations. Teachers have been shouldered with the responsibility of processing it through a formal system to the level of the students. Teachers handle information coming from outside, organise data, enable the learner to raise problems, generate concepts and solutions to the problems with the use of verbal and non-verbal symbols. He is a powerful agent in determining the processing of information by reducing the amount of natural behaviour of children instituting the instructional patterns, building a social system and regulating the instructional process.

Teachers are probably the most important factor influencing the question of how to teach? The word ‘teach’ has a long history and its meaning varied from one period to another. According to its semantic derivation, to teach means to show someone through signs or symbols: to use signs or symbols to evoke responses about events, persons, observations, findings and so forth. It is considered both art and science. As an art it emphasises the imaginative and artistic abilities of the teacher in creating a worthwhile situation in the classroom to enable students to learn. As a science it focuses on the logical, mechanical and procedure steps to be followed to attain an accomplishment of goals. The definitions of teaching are given below:

- Smith (1960) quoted “Teaching is a system of actions intended to induce learning.”
- Gage (1963) defined “By teaching, we mean..... any interpersonal influence aimed at changing the behaviour potential of another person can or will behave. This restriction to interpersonal influence is intended to rule out physical (e.g. mechanical), physiological, or economic ways of influencing another’s behaviour such as pushing him, dragging him or depriving him of a job. Rather the influence has to impinge on the other person through his perceptual and cognitive processes i.e. through his ways infer meaning out of objects and events that his senses make aware of.”
• Mehra (2004) extended a definition of teaching as “When a person imparts information or skills to another, it is common to describe the action as teaching.”

• Davies and Glaser (1962) have pointed out that the entire structure of teaching has four steps:

  *Step 1:* Planning of teaching which includes content analysis, identification and writing of objectives.

  *Step 2:* Organization of teaching which indicates the teaching strategies for achieving the objectives of teaching.

  *Step 3:* Identification of suitable teaching-learning strategies for effective communication of content.

  *Step 4:* Managing teaching-learning, whereby the focus is on the assessment of the learning objectives in terms of student performance and this forms the feedback to teacher and students.

Bruner, Goodnow & Austin (1972) emphasized four major features of theory of instruction in effective teaching:

i) Predisposition towards learning

ii) Structural body of knowledge

iii) Sequences of material to be learnt

iv) The nature and paring of reward and punishment.

1.1.1 DIFFERENT TRENDS IN METHOD OF TEACHING

Teaching is an art in so far as excellence teachers are born but not made. But teaching is also a science in so far as mediocre teacher can become a good teacher by learning good communication with his pupils in accordance with some principles of psychology and sociology. Large scale experimentation spread over the whole world has changed the face of teaching-learning process and has put forth a number of teaching strategies. The influence of electronic media has brought a revolution in the field of education through radio, television, video cassettes, tape recorder, computer-assisted learning (electric and electronic media) VCD (Video compact disc), DVD
(Digital video disc), computers. To complement it various models of teaching are being increasingly used in the field of education. In the modern times several theories of teaching have been developed. It resulted in many good methods of teaching that are the ways to understand and practice the art of teaching.

1.1.2 CONVENTIONAL MODEL OF TEACHING

Teacher plays a pivotal role in the teaching learning process of the classroom. In conventional model of teaching, teacher is the centre of the classroom activities performed in the teaching-learning process. The teacher presents the entire content of the learning. The students play the role of passive listening only. In this model usually teachers do not preplan their lessons, objectives are not related to behavioural terms and stepwise evaluation of knowledge attainment by the students is not undertaken during teaching. In conventional model of teaching, it is focused on narration by the teacher and on the part of pupil it is focused on listening, retention and recall. The teaching environment is very much formalized. In traditional methods pupil acquires knowledge or information without opportunity of understanding and application of practical skills. It does not enable them to correlate the acquired knowledge to the daily living.

1.2 MODELS OF TEACHING

Models of teaching are designed to impart repertories while helping students to learn information, ideas, academic skills, developing social skills, values and understand themselves and their environments (Joyce & Weil, 1972).

How teaching is conducted has a large impact on student’s abilities to educate themselves. “Successful teachers are not simply charismatic and persuasive presenters. Rather they engage their students in robust cognitive and social tasks and teach the students how to use them productively.” (Joyce & Weil, 1997). The major role of teaching is to create powerful learners. Effectiveness of teaching enables learners to draw information, ideas and wisdom from their teachers and use learning resources effectively. Students will change as their repertoire of learning strategies increases and they will be able to accomplish more and more types of learning more effectively. For the purpose a plan or pattern can be used to design face to face teaching in classroom. These prescriptive teaching techniques designed to accomplish
specific goals is called a model approach to teaching. Models differ from teaching strategies. The use of models requires an ability to specify precise learner outcome so that a specific model can be selected to match a particular goal. A model of teaching consists of guidelines for designing educational activities and environments. The models of teaching are meant for creating an environment for proper learning (Passi & Sansanwal 1986). They provide specifications for constructing learning situations. Model of teaching is a plan that can also be utilized to shape courses of studies to design instructional material and guide instructions. These models are often considered to be teaching strategies that help the learner to learn effectively and meaningfully.

1.2.1 MEANING OF MODELS OF TEACHING

- According to Eggen & Kauchak (1988), “Models are prescriptive teaching strategies designed to accomplish particular instructional goals. They are prescriptive in the teacher’s responsibilities during the planning, implementing and evaluating stages are clearly defined.”

- According to Joyce & Weil (1985), “Model of teaching is a pattern or plan which can be used to shape a curriculum or course, to select, instructional material and to guide teacher’s action. Models are designed to attain specific goals.”

They have given some more meanings of teaching models:

(i)  “Teaching models are just instructional designs. They describe the process of specifying and producing particular environmental situations which cause the student to interact in such a way that specific change occurs in his behaviour.”

(ii)  “A model of teaching consists of guidelines for designing educational activities and environments. It specifies ways of teaching and learning that are intended to attain certain kinds of goals.”

Joyce & Weil (1980) selected models of teaching from an enormous list of models. In their views they constitute a basic educational repertoire which helps in accomplishing most goals of learning. They have grouped them into four families that represent distinct orientations towards people and how they learn. The four families are given below:
(i) Social Interaction Models
(ii) Information Processing Models
(iii) Personal Models
(iv) Behavioural Models

The scope of research in this field is very vast because the concept of models of teaching is multi-dimensional. There is not one but many models and these models are at different stages of development.

1.2.2 CLASSIFICATION OF MODELS OF TEACHING

At present there exists a variety of models of teaching, which are based on theories of learning and teaching developed in various fields. These models have been classified in four families by Joyce & Weil (1985). In each family there is a group of models. The classification of models of teaching is shown in Table 1.1

<table>
<thead>
<tr>
<th>Families</th>
<th>The social family</th>
<th>The information processing family</th>
<th>The personal family</th>
<th>The Behavioural Systems Family</th>
</tr>
</thead>
<tbody>
<tr>
<td>Models</td>
<td>Partners in learning</td>
<td>1. Inductive thinking (classification oriented)</td>
<td>1. Non directive teaching</td>
<td>1. Mastery learning</td>
</tr>
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<td></td>
<td>1.1 Positive interdependence</td>
<td>2. Concept attainment</td>
<td>2. Enhancing self esteem</td>
<td>2. Direct instruction</td>
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<td></td>
<td>1.2 Structural inquiry</td>
<td>3. Mnemonics (memory assists)</td>
<td></td>
<td>3. Simulation</td>
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<td></td>
<td>3. Role playing</td>
<td>5. Scientific inquiry</td>
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<td>5. Programmed Schedule (task performance reinforcement)</td>
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<td></td>
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<td>7. Synectics</td>
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1.3 CONCEPT ATTAINMENT MODEL

Generally speaking concepts are groupings of ideas or entities based upon shared features or attributes. The instructional design literature discusses two primary categories of concepts. Concrete Concepts are identified by pointing to specific entities having a tangible presence (i.e. physical objects). However, defined concepts
are abstract categorizations, often defined in terms of their relationship to other concepts (i.e. democracy, liberty, and friend). Defined concepts may be more challenging to learn because of their abstract and less tangible nature (Smith & Ragan, 2005). Concepts are efficiently organized into hierarchical structures that signify their relationships to other concepts (Merrienboer, 1997). These structures form taxonomies that illustrate how super-ordinate, successive/coordinate, and subordinate concepts relate to one another (Merrill, 1992).

Rand (1990) defined concepts as, “The mental integration of two or more units which are isolated according to a specific characteristic(s) and united by a specific definition”.

As concept learning in education forms an important component of the study. Concept attainment is a composite term consisting of two parts i.e. concept and attainment. Concept is a critical component of an individual's cognitive structure. Concepts are the building blocks for the structure of knowledge about the environment. Attainment is a transactional process. An individual organizes whatever he receives by the way of information from whatever source. According to current conceptual system, the attainment of concepts is of utmost importance for elementary school students as they learn and communicate with the help of concepts. The acquisition of knowledge is possible only through concept attainment because knowledge is a chain of concepts.

Concept attainment is often taught using methods such as supplying definitions and providing participants with a series of examples and non-examples (Klausmeier & Feldman, 1973). Likewise, evaluating a learner's attainment of a target concept is often based upon a learner's ability to supply definitions, list attributes, and classify instances of the target concept (Klausmeier, 1974; Merrill, Tennyson & Posey, 1992; Merrill & Tennyson, 1971). Additionally, comprehension may be displayed by asking the learner to identify a target concept's relationship to its hierarchical structure (Merrienboer, 1997). Producing a definition or identifying an instance of a target concept that one has previously observed often isn't considered a sufficiently valid form of assessment (Feldman & Klausmeier, 1974; Merrill, Tennyson & Posey, 1992; Merrill, Olsen & Coldeway, 1976). The nature of language encourages multiple
meanings and thus classifying concepts requires more than a definition, it requires examples to provide clarity and specificity.

Teachers should orient their teaching towards conceptual understanding of underlying concepts. Classrooms are immensely complex places producing effective learning activities entails studying the learning promoted in classroom environments and modifying materials and teaching strategies to enhance the learning that goes on (Driver, 1986).

Concept attainment model is an indirect instructional strategy that uses a structured inquiry process. It is based on the work of Bruner. In concept attainment, students figure out the attributes of a group or category that has already been formed by the teacher. To do so, students compare and contrast examples that contain the attributes of the concept with examples that do not contain those attributes. Then they separate them into two groups i.e. examples and non-examples. Concept attainment is the search for and identification of attributes that can be used to distinguish examples of a given group or category from non-examples.

The design of this model, first suggested by Joyce & Weil (1972), is based on the research of Bruner, Goodnow & Austin (1956) who entitled it, ‘A Study of Thinking’. Usually it is named as Bruner’s concept attainment model. The concept attainment model belongs to the category of information processing model. There are three types of concept attainment model: (i) Reception model (ii) Selection model and (iii) The analysis of concepts in unorganized data.

Klausmeier (1985) considered concept attainment model as an inductive teaching strategy designed to help students of all ages learn concepts and practice analytical thinking skills based upon fundamental concept learning research.

1.3.1 ASSUMPTION AND RATIONALE OF THE CONCEPT ATTAINMENT MODEL

The environment around us is becoming increasing complex. In order to function effectively we are required to develop a thorough acquaintance with it. To reduce this complexity of the environment, we render discriminately different things equivalent, responding to them in items of their class membership rather than their uniqueness. Bruner and his associates (1977) consider categorizing as the “Principle
means through which a growing member of a society is socialized and they assume that all sets of concepts are the product of same kind of thought processes, and the means of acquiring any concept is essentially the same.” In the view of Bruner, categorizing activity actually has two components, the act of concept formation and the act of concept attainment. In the act of concept formation, the new categories are formed. In concept attainment the concept already exists but concept formation precedes the concept attainment.

According to Bruner, Goodnow & Austin (1956), any concept has five elements (i) Name (ii) Examples (positive and negative) (iii) Attributes (essential and non-essential) (iv) Attribute values and (v) Rule. Understanding a concept means knowing all the elements of the concept.

(i) **Name** is the term given a category i.e. fruit, fish, democratic government and election. These are all names to a class of experiences, objects, configurations, or process.

(ii) **Examples** refer to the instances of the concept. In the concept attainment exercise, each work is an example of concept such as fruit and animal. All the examples, which are the instances of the concepts, are the positive example and other, which is not the instances of the concept, are the negative examples.

(iii) **Attributes** are the common characteristics that cause us to place examples in the same category. In case of fruits the attributes are (i) fleshy (or dry), (ii) sweet (or sour), (iii) edible (or not edible) and (iv) cost (high or low). Some of these attributes are essential attributes others are nonessential attributes.

(iv) **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.

(v) **Rules** refer to a final statement specifying the essential attributes of a concept. A rule normally evolves at the end of the concept attainment process. The teacher often uses it as a device to have students summarize the findings of their search for attributes.
1.3.2 ELEMENTS OF CONCEPT ATTAINMENT MODEL

The components of the concept attainment reception oriented model have been presented below:

(i) **Focus**: The main focus of the model is to develop inductive reasoning of the students. Bruner and his associates orient their work for the description of a process by which the students discriminate the attribute of the things, persons and events and place them into categories. The students are also taught about the concept which is of great use to them in order to live successfully in different life situations.

(ii) **Syntax**: **Phase one** of the model involves presentation of data. Each unit of data is a separate unit of example or non-example of the concept. The data may be event, objects, people, stories, pictures or any other discriminable unit. The students are informed that there is one idea that all the positive examples have in common; their task is to develop a hypothesis about the concept. Teacher presented the instances labeled with ‘yes’ or ‘no’ in a pre-arranged order. Students are asked to compare them all and to name the inherent concept and state the rule or definition of the concept according to its essential attributes. Learners are informed that all the positive examples marked yes have some attributes in common and the negative examples marked no contrast with those common attributes. **Phase two** involves the testing of the concept attainment. The teacher presents the unlabelled examples and the students are asked to generate example and non-example of their own. After this, teacher and students confirm their original hypothesis, revising their choice of concept on attributes as necessary. **Phase three** students begin to analyze the strategies by which they have attained the concept. They describe the pattern of focuses and the role of hypothesis. They also describe the number of hypotheses formulated. **Finally** an attempt is made to provide a formal definition of the attained concept. Structure of the model has the following phases.
(iii) **Social System:** In the reception model of concept attainment, the teacher chooses the concepts to be taught and selects and presents the examples and non-example of the concept in a sequence. The role of the teacher is to provide data to direct students and guide them in attaining the concept. The learners actively participate. The climate of the class is generally warm, competitive and friendly. Thus, the three major functions of the teacher during this model are to record, prompt (cue) and present additional data.

(iv) **Principle of reaction:** This aspect tells the teacher how to regard the learner and how to respond to what the learner does. Immediate check of wrong answers and acceptance of right answers may be as follows:

a) Maintain a vigorous intellectual climate.

b) Respect all views and avoid direct evaluation of student opinions.

c) See that issues are thoroughly explored.

d) Probe for relevance, consistency, specificity, generality, definitional clarity and continuity.

e) Avoid taking a stand.

f) Maintain dialectical style.

(v) **Support system:** The lessons require concepts which can be arranged so that concept may be drawn from the material. Concept attainment lesson requires specially designed material with positive and negative examples of the concepts presented in the course. The data sources are essential to be known before hand and all the aspect attainment activity should be made visible.

(vi) **Application of Model:** Concept attainment model is very useful in teaching the concepts through inductive reasoning. This model may be used with students of all ages and grade level. This model is an excellent evaluation tool when the teachers want to determine whether important ideas introduced earlier have been mastered. It reveals the depth of student understands and reinforces their previous knowledge. Concepts attainment lessons may be used in all the subjects.
Instructional and Nurturant Effects: The model has been successfully used for instruction of the variety of concepts, for correcting and improving the already learnt concepts. It also provides training in inductive reasoning and sensitivity and awareness of alternative perspectives.

1.3.3 SELECTION THINKING STRATEGIES

The type of instructional condition (reception or selection) influences the particular thinking strategy that the students will employ. Bruner and his associates (1972) have identified six strategies in concept attainment i.e. Four selecting strategies and two reception strategies. The four selection strategies are given below:

(i) **Simultaneous Scanning Strategy** - In a simultaneous scanning, people use each example to determine which hypothesis to hold and which to eliminate, and they hold more than one hypothesis at a time. This technique is not very efficient since it places a great deal of strain on the subject’s memory.

(ii) **Successive Scanning Strategy** - In this technique the subject makes an overall estimate of each correct characteristics of the concept and test, each one by one. This is called successive scanning since the subject tests individual hypothesis about the correct characteristics one at a time in succession.

(iii) **Conservative Focusing Strategy** - In this technique, each attribute is tested by selecting a card that is different from a focus card in only one attribute. If the new card is still a positive instance, then the subject knows that the varied attribute is not part of the concept. If however, the changed attribute yields a negative instance, then the attribute is a part of the concept. This technique is more efficient since the subject uses a correct instance as a point of reference and selects additional cards to test each attribute value individually.

(iv) **Focus Gambling Strategy** - In this strategy the subject focuses on a correct card, but varies more than one attribute at a time. This technique can give early result if cards chosen yield a positive instance. If, however the subject encounters a negative instance, he cannot tell which attribute was essential. In that case he has to revert to simultaneous scanning technique to test
hypothesis. This strategy is called focus gambling since the subject takes a
case varying two attributes at a time.

1.3.4 RECEPTION THINKING STRATEGIES

The reception thinking strategies are more direct in teaching students the
elements of a concept and their use in concept attainment. It enables students to
understand fully the similarities and relationship among various things of the
environment. The two reception strategies are:

(i) **Wholist Strategy** - Wholist strategy is to take the positive instance of the
concept and use it as a guide, comparing all the attributes of the first instance
to those of subsequent instance and modifying the hypotheses accordingly.
The first instance then became the concept hypothesis, and subsequent
decisions depend on the attribute similarity and difference between the first
instance and subsequent one.

(ii) **Partist Strategy** - Partist strategy, the choice of a hypothesis is based on only
part of the initial example. In the first example, the initial hypothesis might
have been the letter A. If the initial hypothesis is not confirmed, the partial
refers to all previous instances and changes the hypothesis.

1.4. LEARNING

Learning is acquiring new knowledge, behaviours, skills, values, preferences
or understanding and may involve synthesizing different types of information. The
ability to learn is possessed by humans and animals. Human learning may occur as
part of education, personal development, or training. It may be goal-oriented and may
be aided by motivation. The study of how learning occurs is part of neuropsychology,
educational psychology, learning theory, and pedagogy. Learning may occur as a
result of habituation or classical conditioning, seen in many animal species, or as a
result of more complex activities such as play, seen only in relatively intelligent
animals. Learning may occur consciously or without conscious awareness.

Learning is a transactional process. An individual organizes whatever he
receives by the way of information from whatever source. The learning of concepts is
of greater importance for human beings as they think, learn and communicate with the help of concepts. The present era is the age of computerized industry and research. The exploding population in some areas of the globe along with shrinking resources compels us to produce and grow more under high economic conditions and also compels to explore space to find additional place and resources and also information to predict weather and other natural changes.

According to Columbia Encyclopedia (2007), “Learning, in psychology, the process by which a relatively lasting change in potential behaviour occurs as a result of practice or experience. Learning is distinguished from behavioural changes arising from such processes as maturation and illness, but does apply to motor skills, such as driving a car, to intellectual skills, such as reading, and to attitudes and values, such as prejudice. There is evidence that neurotic symptoms and patterns of mental illness are also learned behaviour. Learning occurs throughout life in animals, and learned behaviour accounts for a large proportion of all behaviour in the higher animals, especially in humans.”

Melvin & Marx (1971) defines learning as “Learning is a relatively enduring change in behaviour which is a function of prior behaviour (usually called practice).”

According to Britannica Encyclopedia (2010), “Process of acquiring modifications in existing knowledge, skills, habits, or tendencies through experience, practice, or exercise. Learning includes associative processes discrimination of sense-data, psychomotor and perceptual learning imitation, concept formation, problem solving, and insight learning. Animal learning has been studied by ethologists and comparative psychologists, the latter often drawing explicit parallels to human learning. The first experiments concerning associative learning were conducted by Ivan Pavlov in Russia and Edward L. Thorndike in the U.S. Critics of the early stimulus-response (S-R) theories, such as Edward C. Tolman, claimed they were overly reductive and ignored a subject's inner activities. Gestalt-psychology researchers drew attention to the importance of pattern and form in perception and learning, while structural linguists argued that language learning was grounded in a genetically inherited "grammar." Developmental psychologists such as Jean Piaget
highlighted stages of growth in learning. More recently, cognitive scientists have explored learning as a form of information processing, while some brain researchers, such as Gerald Maurice Edelman, have proposed that thinking and learning involve an ongoing process of cerebral pathway building. Related topics of research include attention, comprehension, motivation, and transfer of training.”

1.4.1 MODELS OF LEARNING

The scientific investigation of the learning process was begun at the end of the 19th century by Ivan Pavlov in Russia and Edward Thorndike in the United States. Three models are currently widely used to explain changes in learned behaviour; two emphasize the establishment of relations between stimuli and responses, and the third emphasizes the establishment of cognitive structures. According to Columbia Electronic Encyclopedia (2007) models of learning are of following kinds:

**Classical Conditioning:** The first model, classical conditioning, was initially identified by Pavlov in the salivation reflex of dogs. Salivation is an innate reflex, or unconditioned response, to the presentation of food, an unconditioned stimulus. Pavlov showed that dogs could be conditioned to salivate merely to the sound of a buzzer (a conditioned stimulus), after it was sounded a number of times in conjunction with the presentation of food. Learning is said to occur because salivation has been conditioned to a new stimulus that did not elicit it initially. The pairing of food with the buzzer acts to reinforce the buzzer as the prominent stimulus.

(i) **Operant Conditioning:** A second type of learning, known as operant conditioning, was developed around the same time as Pavlov's theory by Thorndike, and later expanded upon by B. F. Skinner. Here, learning takes place as the individual acts upon the environment. Whereas classical conditioning involves innate reflexes, operant conditioning requires voluntary behaviour. Thorndike showed that an intermittent reward is essential to reinforce learning, while discontinuing the use of reinforcement tends to extinguish the learned behaviour. The famous Skinner box demonstrated operant conditioning by placing a rat in a box in which the pressing of a small bar produces food. Skinner showed that the rat eventually learns to press the
bar regularly to obtain food. Besides reinforcement, punishment produces avoidance behaviour, which appears to weaken learning but not curtail it. In both types of conditioning, stimulus generalization occurs; i.e., the conditioned response may be elicited by stimuli similar to the original conditioned stimulus but not used in the original training. Stimulus generalization has enormous practical importance, because it allows for the application of learned behaviours across different contexts. Behaviour modification is a type of treatment resulting from these stimulus response models of learning. It operates under the assumption that if behaviour can be learned, it can also be unlearned.

(ii) **Cognitive Learning**: A third approach to learning is known as cognitive learning. Wolfgang Kohler showed that a protracted process of trial-and-error may be replaced by a sudden understanding that grasps the interrelationships of a problem. This process is called insight and it is more similar to piecing together a puzzle than responding to a stimulus. Tolman & Honzik (1930) found that unrewarded rats learned the layout of a maze, yet this was not apparent until they were later rewarded with food. They called this latent learning, and it has been suggested that the rats developed cognitive maps of the maze that they were able to apply immediately when a reward was offered.

### 1.5 RETENTION

Learning involves three stages: acquisition of information (physical encoding in the brain), retention of information and the ability to retrieve that information when needed. Gardner (1983) in his multiple intelligences theory and Kolb (1984) in his experiential learning cycle theory of learning supported recent cognitive science research. Information must be accessible when it is needed or appropriate. In order to form a memory (acquisition), information must catch our attention. There are two types of attention: semantic (how the world works) and episodic (associated with time, place or people). Memory retention is enhanced by addressing interference (the effect that other information has on learning or retaining new materials). Interference can be proactive, which occurs when the new information is inconsistent with what
we already know – stereotyping is a pernicious example. Retroactive interference occurs when new information interferes with what we had already learned, but only when the information is similar to the first information. Memory access is related to how memories are organized such as categories, hierarchies and/or schemas.

Retention is an active state of learned performance. What is retained during the inactive state must be something in the form of a structure activity. Some modified structure of the organism, mostly modified brain structure is left behind. These modified structures are often called as the memory trace. Hence, retention is very difficult to improve by practice. The capacity of retention is native and cannot be improved by training.

Retention plays an important role in our daily life. Our life becomes richer if we are able to retain past experiences which make living pleasant and enjoyable. This ability to remember plays an important role in the process of learning which is essential for our intellectual life. With the help of thinking, we attempt to do new things and solve a numerous problems that we face in our daily life. But all thinking is based on remembering. Thus remembering is an important aid for progress in learning and constructive thinking.

According to Encyclopedia Britannica (2010), “Retention is learning is to acquisition as memory is to retention. Psychomotor retention scores indicate the percentage or degree of originally learned skill that is remembered or recalled as a function of elapsed time.”

1.5.1 METHODS OF MEASURING RETENTION

Four methods are used for measuring the amount of retention such as:

(i) **Recall method:** This method requires a person to reproduce correctly what previously learned. Recall is very simple to measure, you show some list of words to the students and after an exposure for a specified time asks them to recall as many items as possible. This method of recall is often used in schools. Frequent examinations after every month give an opportunity to students for active recall.
(ii) **Recognition method:** Another method of testing retention is recognition. In it subject is shown the material which he learned together with other items, which he has not known before, and he is expected to identify the items which occurred in the original material.

(iii) **Relearning method:** In it the number of trials a person requires to reach a learning objective is recorded. After an interval in which forgetting occurs, subjects reach the same objective and number of trials required for re-learning is compared with the number required for the first time. The difference or savings represents the effect of retention.

(iv) **Reconstruction method:** When material has been learned in a serial order and learner is given the original item in a mixed up form and is asked to re-arrange them in an original order, i.e. to reconstruct the original order.

### 1.6 COGNITIVE STYLES

A comprehensive review of research in cognitive psychology has indicated that people exhibit significant individual differences in the cognitive processing styles that they adopt in problem solving and other similar decision-making activities (Robertson, 1985). As for individual differences, different researchers have different definitions and conduct research from different perspectives accordingly. The construct of cognitive styles was originally proposed by Allport (1937), referring to an individual’s habitual or typical way of perceiving, remembering, thinking, and problem solving. Since then, especially in the last few decades, there has been additional considerable research in this area.

"The commonly shared view that cognitive style differences between human beings were possibly due to differences in left/right hemispheric specialisation of the brain" (Armstrong 1999, pp. 31-50). Messick (1976) considers cognitive style a psychological term which refers to variations among individuals in preferred ways of perceiving, organising, analysing, or recalling information and experience. Cognitive styles are also viewed as the typical means of problem solving, thinking, and remembering. Cross (1976) refers to cognitive styles as the characteristic ways of using the mind and is frequently considered as one element among other elements comprising learning style (Schultz, 1985; Kocinski, 1984).
There are many different definitions of cognitive style.

- Hilgard and Bower (1986) defined “Cognitive styles are conceptualised as stable attitudes, preferences or habitual strategies determine a person’s typical modes of perceiving, receiving, remembering, thinking and problem solving”.

- Tennant (1988) defined cognitive styles as "An individual’s characteristic and consistent approach to organizing and processing information."

- Riding, Glass, & Douglas (1993) termed cognitive styles as "A fairly fixed characteristic of an individual" and "are static and relatively in-built features of the individual."

Cognitive styles refer to the preferred way individual processes information. Unlike individual differences in abilities which describe peak performance, styles describe a person's typical mode of thinking, remembering or problem solving.

Yuliang (1999) reported that cognitive style has been broadly investigated by psychologists. Messick (1976) identified as many as 19 cognitive styles. Different researchers emphasize different aspects of cognitive styles. Therefore, there are various terms encountered in the literature related to this area. These terms include breadth of categorizing (Kogan & Wallach, 1964), cognitive complexity vs. cognitive simplicity (Kelly, 1955), deep-elaborative vs. shallow-reiterative (Schmeck, 1983), divergent vs. convergent (Hudson, 1966), field dependence vs. field independence (Witkin, 1962), global vs. analytical (Kirby, 1988), impulsive vs. reflectivity (Kagan, 1965), leveller vs. sharpener (Holzman & Klein, 1954), need for cognition (Tanaka, Panter & Winborne, 1986-87), objective vs. nonobjective (Leithwood & Montgomery, 1982), organizer vs. nonorganizer (Atman, 1988), right- brained vs. left-brained (Torrance & Rockenstein, 1988), risk-taking vs. cautiousness (Kogan & Wallach, 1964; Kogan, 1971), scanning vs. focusing (Gardner, 1961), sensitizers vs. repressors (Bergouist, Lloyd, & Johansson, 1973), sensory modality preferences (Bartlett, 1932; Galton, 1883), simultaneous vs. successive (Das, 1988), verbalizer vs. imager (Riding & Taylor, 1976), verbalizer vs. visualizer (Richardson, 1977), visual vs. haptic perceptual type (Lewenfeld, 1945); holist vs. analytic (Peters, 1977), holist-analytic vs. verbal-imagery (Riding & Cheema, 1991), holist vs. serialist (Pask,
Cognitive style or thinking style is a term used in cognitive psychology to describe the way individuals think, perceive and remember information, or their preferred approach to using such information to solve problems. The terms learning style or cognitive style have been widely used by educational theorists for the past sixty years. Terminology has varied from writer to writer (Curry, 1983; Riding & Cheema, 1991) although, many (e.g. Witkin et al, 1971; Goldstein & Blackman, 1978; Tennant, 1988; Biggs & Moore, 1993; Riding & Pearson, 1994) have agreed that cognitive style is a distinct and consistent way for an individual to encode, store and perform, and one that is mainly independent of intelligence.

Heineman (1995) considerable confusion appears in the literature concerning the terms cognitive style and learning style. Numerous authors use the terms interchangeably. McFadden (1986) states that most definitions of learning style as well as cognitive style, illustrate variations in individual information processing and that no single definition for learning style or cognitive style has been identified. Descriptions of cognitive style, notes McFadden, include: a consistent pattern of behaviour within a range of individual variability (Cornet, 1983); a student's consistent way of responding to and using stimuli in a learning environment (Claxton & Ralston, 1978); how individuals process information and prefer to learn (Garity, 1985); the way individuals organize information and experiences (Laschinger & Boss, 1984); a person's characteristic style of acquiring and using information (Haynsake, 1981) and; an expression of psychological differentiation within characteristic modes of information processing (Witkin & Goodenough, 1971, 1981). Zarghani (1988) notes that learning styles are the cognitive, affective, and psychological traits that serve as relatively stable indicators of how learners perceive, interact with, and respond to the learning environment (Keefe, 1982). Learning style explains the interaction of different instructional methods with cognitive or personality characteristics of the learners. The term is also referred to as aptitude (or attitude) or treatment interaction (Borg & Gall, 1983). Hunt (1982) defined learning style as a formal attempt to capture what goes on in effective communication.
Yuliang (1999) says “In most situations, cognitive styles and learning styles are used interchangeably.” Kocinski (1984) citing Goodman (1970) states that learning styles may be cognitive or affective or a combination of both. Keefe (1979) suggests that learning styles are cognitive, affective and psychological behaviours that serve as relatively stable indicators of how learners perceive, interact with and respond to the learning environment.

1.6.1 HEMISPHERIC PREFERENCES

A cerebral hemisphere (hemispherium cerebrale) is one of the two regions of the eutherian brain that are delineated by the median plane, (medial longitudinal fissure). The brain can thus be described as being divided into left and right cerebral hemispheres. Each of these hemispheres has an outer layer of grey matter called the cerebral cortex that is supported by an inner layer of white matter. The hemispheres are linked by the corpus callosum, a very large bundle of nerve fibers, and also by other smaller commissures, including the anterior commissure, posterior commissure, and hippocampal commissure. These commissures transfer information between the two hemispheres to coordinate localized functions. The architecture, types of cells, types of neurotransmitters and receptor subtypes are all distributed among the two hemispheres in a markedly asymmetric fashion. However, while some of these hemispheric distribution differences are consistent across human beings, or even across some species, many observable distribution differences vary from individual to individual within a given species.

Neuropsychologist Sperry (1960) developed the right brain-left brain theory. For this was awarded the Nobel Prize in 1981. He believed that the human brain is right or left side dominant and that each side of the brain controls different types of thinking. Some individuals utilize both sides of their brains equally (all use both to some degree) but most people have a greater tendency to think in a certain way.

Ornstein's hemispherical lateralization concept, commonly called left-brain/right-brain theory, posits that the left hemisphere of the brain controls logical and analytical operations while the right hemisphere controls holistic, intuitive and pictorial activities. Cognitive style is thus claimed to be a single dimension on a scale from extreme left-brain to extreme right-brain types, depending on which associated behaviour dominates in the individual, and by how much.
Ned Herrmann (1990) is 'Father of brain dominance technology'. He drew on the work of Sperry and developed the theory brain dominance where people develop a dominant mode of thinking preference. These can range from an analytical "left brain" approach to "right brain" approaches involving pattern matching and intuitive understanding. These preferences have their roots in our genetic makeup and how it affects our underlying cognitive capabilities. For example left-right handed preferences have been observed in the womb. As we develop we tend to respond with our strongest abilities as these lead to quicker short-term rewards. This can create a positive feedback system that will strengthen those abilities. Eventually this can lead to a powerful preference for one style over the other and a dislike and discomfort for other modes of thinking.

1.6.2 Differences between Left and Right Hemisphere

One way of looking at cognitive styles is to determine your hemispheric dominance. Are you more right brained or left brained? We know that the cerebral cortex is the part of the brain that houses rational functions. It is divided into two hemispheres connected by a thick band of nerve fibers (the corpus callosum) which sends messages back and forth between the hemispheres. And while brain research confirms that both sides of the brain are involved in nearly every human activity, we do know that the left side of the brain is the seat of language and processes in a logical and sequential order. The right side is more visual and processes intuitively, holistically, and randomly. Most people seem to have a dominant side. A key word is that our dominance is a preference, not an absolute. When learning is new, difficult, or stressful we prefer to learn in a certain way. It seems that our brain goes on autopilot to the preferred side. While nothing is entirely isolated on one side of the brain or the other, the characteristics commonly attributed to each side of the brain serve as an appropriate guide for ways of learning things more efficiently and ways of reinforcing learning. Just as it was more important for our purposes to determine that memory is stored in many parts of the brain rather than learn the exact lobe for each part, likewise it is not so much that we are biologically right brain or left brain dominant, but that we are more comfortable with the learning strategies characteristics of one over the other. What you are doing is lengthening your list of strategies for learning how to learn and trying to determine what works best for you. You can and
must use and develop both sides of the brain. But because the seat of our preferences probably has more neural connections, learning may occur faster.

There are a few basics. First, no one is totally left-brained or totally right-brained. Just as you have a dominant hand, dominant eye, and even a dominant foot, you probably have a dominant side of the brain. Second, we can and must develop both sides of our brain.

Wheeler (2001) states most individuals have a preference for one of these styles of thought and a very few gifted individuals are able to use both sides of their brains equally well. These are known as zero or cross-laterality thinkers and can also be referred to as 'whole brain' individuals. School systems in the western world generally favor left brain approaches to education, whilst neglecting the right brain specialties. Right brain dominant individuals can therefore often be disadvantaged in education.

There is a large body of research about hemispheric preferences. Researchers have conducted relevant studies from different perspectives, such as psychological, physiological and neurological. According to Sonnier (1991), hemispheric preferences might be a major contributing factor to individual differences. That is, left-hemispheric students are strong in analytical thought processing, while right-hemispheric students are visual processors. In addition, O'Boyle (1986) proposed that the difference in cognitive processing between the two hemispheric asymmetries was more quantitative than qualitative in nature. In other words, it is primarily a matter of degree rather than absolute ability.

Many studies have shown that hemispheric preferences play a very important role in cognition and achievement. According to O'Boyle & Hellige (1989), hemispheric asymmetry, such as degree of dominance, direction of dominance, characteristic arousal level, and complementarity of functioning, play an important role in individual differences in cognition. According to Gadzella & Kneipp (1990), right-hemispheric students process information nonlinearly and holistically, but left-hemispheric students’ process information logically and sequentially. In addition, according to Gadzella (1995), left-hemispheric students achieve higher grades than right-hemispheric ones, especially when the grades are primarily based on the objective test. Some specific differences between the two hemispheres have been mentioned in Table 1.2.
### Table 1.2: Specific differences between right and left hemispheres

<table>
<thead>
<tr>
<th>Mode</th>
<th>Right hemisphere</th>
<th>Left hemisphere</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Speech</strong></td>
<td>. Left ear</td>
<td>. Right ear</td>
</tr>
<tr>
<td></td>
<td>. Analysis of voice intonation</td>
<td>. Analysis of speech-sounds</td>
</tr>
<tr>
<td><strong>Language</strong></td>
<td>. Tonal memory</td>
<td>. Verbal memory</td>
</tr>
<tr>
<td></td>
<td>. Musical hearing and melody</td>
<td>. Expression through speech</td>
</tr>
<tr>
<td><strong>Visual</strong></td>
<td>. Left eye movers</td>
<td>. Right eye movers</td>
</tr>
<tr>
<td><strong>Thinking</strong></td>
<td>. Divergent</td>
<td>. Convergent</td>
</tr>
<tr>
<td></td>
<td>. Holistic</td>
<td>. Abstract</td>
</tr>
<tr>
<td></td>
<td>. Intuitive</td>
<td>. Logical</td>
</tr>
<tr>
<td></td>
<td>. Random</td>
<td>. Sequential</td>
</tr>
<tr>
<td></td>
<td>. Holistic</td>
<td>. Rational</td>
</tr>
<tr>
<td></td>
<td>. Synthesising</td>
<td>. Analytical</td>
</tr>
<tr>
<td></td>
<td>. Subjective</td>
<td>. Objective</td>
</tr>
<tr>
<td></td>
<td>. Recalling pictures and images</td>
<td>. Recalling words, names, and dates</td>
</tr>
<tr>
<td></td>
<td>. Lying down and thinking</td>
<td>. Sitting erect and thinking</td>
</tr>
<tr>
<td><strong>Learning</strong></td>
<td>. Through exploration</td>
<td>. Through examination</td>
</tr>
<tr>
<td><strong>Specialties</strong></td>
<td>. Looks at the parts</td>
<td>. Looks at the whole</td>
</tr>
<tr>
<td></td>
<td>. Copying of designs,</td>
<td>. Skilled movement,</td>
</tr>
<tr>
<td></td>
<td>. Discrimination of shapes e.g. picking out a</td>
<td>. Analytical time sequence processing.</td>
</tr>
<tr>
<td></td>
<td>camouflaged object,</td>
<td></td>
</tr>
<tr>
<td></td>
<td>. Understanding geometric</td>
<td>. Understanding algebra</td>
</tr>
<tr>
<td><strong>Shared</strong></td>
<td>. Sensations on both side of face,</td>
<td>.</td>
</tr>
<tr>
<td></td>
<td>. Sound perceived by both ears,</td>
<td>.</td>
</tr>
<tr>
<td></td>
<td>. Pain,</td>
<td>.</td>
</tr>
<tr>
<td></td>
<td>. Hunger,</td>
<td>.</td>
</tr>
<tr>
<td></td>
<td>. Position.</td>
<td>.</td>
</tr>
<tr>
<td><strong>Emotions</strong></td>
<td>. Negative emotions (fearful mournful feelings),</td>
<td>. Positive emotions</td>
</tr>
<tr>
<td></td>
<td>. Being absentminded sometimes</td>
<td>. Almost never absentminded</td>
</tr>
<tr>
<td><strong>Neurotransmitters</strong></td>
<td>. Higher levels of norepinephrine</td>
<td>. Higher levels of dopamine</td>
</tr>
<tr>
<td><strong>Grey Matter</strong></td>
<td>. More white-matter (longer axons) on right</td>
<td>. More grey-matter (cell bodies) on the left.</td>
</tr>
<tr>
<td><strong>White Matter ratio</strong></td>
<td>. More white-matter (longer axons) on right</td>
<td>. More grey-matter (cell bodies) on the left.</td>
</tr>
</tbody>
</table>
Generally the left and right hemispheres of our brain process information in different ways. We tend to process information using our dominant side. However, the learning process is enhanced when all of our senses are used. This includes using our less dominate hemisphere. Listed below is information processing styles that are characteristically used by our right or left brain.

(i) **Linear vs. Holistic Processing**

(ii) **Logical vs. Intuitive**

(iii) **Sequential vs. Random Processing**

(iv) **Verbal vs. Nonverbal Processing**

(v) **Symbolic vs. Concrete Processing**

(vi) **Reality-Based vs. Fantasy-Oriented Processing**

(i) **Linear vs. Holistic Processing**

The left side of the brain processes information in a linear manner. It process from part to whole. It takes pieces, lines them up, and arranges them in a logical order; then it draws conclusions. The right brain, however, processes from whole to part, holistically. It starts with the answer. It sees the big picture first, not the details. If you are right-brained, you may have difficulty following a lecture unless you are given the big picture first. Now see why it is absolutely necessary for a right-brained person to read an assigned chapter or background information before a lecture or to survey a chapter before reading. If an instructor doesn't consistently give an overview before he or she begins a lecture, you may need to ask at the end of class what the next lecture will be and how you can prepare for it. If you are predominantly right-brained, you may also have trouble outlining (you've probably written many papers first and outlined them latter because an outline was required). You're the student who needs to know why you are doing something. Left-brained students would do well to exercise their right-brain in such a manner

(ii) **Sequential vs. Random Processing**

In addition to thinking in a linear manner, the left brain processes in sequence in order. The left-brained person is a list maker. If you are left-brained, you would
enjoy making a master schedule and doing daily planning. You complete tasks in order and take pleasure in checking them off when they are accomplished. Likewise, learning things in sequence is relatively easy for you. For example, spelling involves sequencing; if you are left-brained, you are probably a good speller. The left brain is also at work in the linear and sequential processing of math and in following directions.

By contrast, the approach of the right-brained student is random. If you are right-brained, you may flit from one task to another. You will get just as much done but perhaps without having addressed priorities. An assignment may be late or incomplete, not because you weren't working, but because you were working on something else. You were ready to rebel when asked to make study schedules for the week. But because of the random nature of your dominant side, you must make lists, and you must make schedules. Because the right side of the brain is color sensitive, you might try using colors to learn sequence, making the first step green, the second blue, and the last red or you may want to "walk" a sequence, either by physically going from place to place or by imagining it.

(iii) **Symbolic vs. Concrete Processing**

The left brain has no trouble processing symbols. Many academic pursuits deal with symbols such as letters, words, and mathematical notations. The left-brained person tends to be comfortable with linguistic and mathematical endeavors. Left-brained students will probably just memorize vocabulary words or math formulas. The right brain, on the other hand, wants things to be concrete. The right-brained person wants to see, feel, or touch the real object. Right-brained students may have had trouble learning to read using phonics. They prefer to see words in context and to see how the formula works. To use your right brain, create opportunities for hands-on activities. Use something real whenever possible. You may also want to draw out a math problem or illustrate your notes.

(iv) **Logical vs. Intuitive Processing**

The left brain processes in a linear, sequential, logical manner. When you process on the left side, you use information piece by piece to solve a math problem.
or work out a science experiment. When you read and listen, you look for the pieces so that you can draw logical conclusions. Your decisions are made on logic—proof. If you process primarily on the right side of the brain, you use intuition. You may know the right answer to a math problem but not be sure how you got it. You may have to start with the answer and work backwards. On a quiz, you have a gut feeling as to which answers are correct, and you are usually right. In writing, it is the left brain that pays attention to mechanics such as spelling, agreement, and punctuation. But the right side pays attention to coherence and meaning; that is, your right brain tells you it "feels" right. Your decisions will be based on feelings.

(v) **Verbal vs. Non-verbal Processing**

Left-brained students have little trouble expressing themselves in words. Right-brained students may know what they mean but often have trouble finding the right words. The best illustration of this is to listen to people give directions. The left-brained person will say something like "From here, go west three sectors and turn north on Madhya Marg. Go three or four miles and then turn east onto Broad Street." The right-brained person will sound something like this: "Turn right (pointing right) by the traffic light (pointing again). Then you will pass a sector 17 and Rose Garden. At the next light, turn right toward the BP station." So how is this relevant to planning study strategies? Right-brained students need to back up everything visually. If it's not written down, they probably won't remember it and it would be even better for right-brained students to illustrate it. They need to get into the habit of making a mental video of things as they hear or read them. Right-brained students need to know that it may take them longer to write a paper, and the paper may need more revision before it says what they want it to say. This means allowing extra time when a writing assignment is due.

(vi) **Reality-Based vs. Fantasy-Oriented Processing**

The left side of the brain deals with things the way they are—-with reality. When left-brained students are affected by the environment, they usually adjust to it. Not so with right-brained students; they try to change the environment! Left-brained people want to know the rules and follow them. In fact, if there are no rules for situations, they will probably make up rules to follow! Left-brained students know the
consequences of not turning in papers on time or of failing a test, but right-brained students are sometimes not aware that there is anything wrong. The right-brained student is creative and since emotion is processed on the right side of the brain, you will probably remember well anything you become emotionally involved in as you are trying to learn.

1.6.3 MEASUREMENT OF COGNITIVE STYLES

(i) Multi-dimensional models and measures

A popular, multi-dimensional instrument for the measure of cognitive style is the Myers-Briggs Type Indicator or MBTI. In recent times, scholars have questioned the construct validity of some of the scales associated with this instrument.

Riding developed a two-dimensional cognitive style instrument, his cognitive style analysis (CSA), which is a compiled computer-presented test that measures individuals' position on two orthogonal dimensions – wholist-analytic (W-A) and verbal-imagery (V-I). The W-A dimension reflects how individuals organise and structure information. Individuals described as analytics will deconstruct information into its component parts, whereas individuals described as wholists will retain a global or overall view of information. The V-I dimension describes individuals' mode of information representation in memory during thinking, verbalizers represent information in words or verbal associations, and imagers represent information in mental pictures. The CSA test is broken down into three sub-tests, all of which are based on a comparison between response times to different types of stimulus items. Some scholars argue that this instrument, being at least in part reliant on the ability of the respondent to answer at speed, really measures a mix of cognitive style and cognitive ability. This is said to contribute to the unreliability of this instrument.

(ii) Bipolar, one-dimensional models and measures

The field dependence-independence model, invented by H. Witkin, identifies an individual's perceptive behaviour while distinguishing object figures from the content field in which they are set. Two similar instruments to do this were produced, the Embedded Figures Test (EFT) and the Group Embedded Figures Test (GEFT) (1971). In both cases, the content field is a distracting or confusing background. These
instruments are designed to distinguish field-independent from field-dependent cognitive types; a rating which is claimed to be value-neutral. Field-independent people tend to be more autonomous when it comes to the development of restructuring skills; that is, those skills required during technical tasks with which the individual is not necessarily familiar. They are, however, less autonomous in the development of interpersonal skills. The EFT and GEFT continue to enjoy support and usage in research and practice. However, they, too, are criticised by scholars as containing an element of ability and so may not measure cognitive style alone.

Hudson identified two cognitive styles: convergent thinkers, good at accumulating material from a variety of sources relevant to a problem's solution, and divergent thinkers who proceed more creatively and subjectively in their approach to problem-solving. Hudson's converger-diverger constructs attempts to measure the processing rather than the acquisition of information by an individual. It aims to differentiate convergent from divergent thinkers; the former being persons who think rationally and logically while the latter tend to be more flexible and to base reasoning more on heuristic evidence.

In contrast, cognitive complexity theories attempt to identify individuals who are more complex in their approach to problem-solving against those who are simpler. The instruments used to measure this concept of "cognitive style" are either Driver's Decision Style Exercise (DDSE) or the Complexity Self-Test Description Instrument, which are somewhat ad hoc and so are little used at present.

Pask (1972) extended these notions in a discussion of strategies and styles of learning. In this, he classified learning strategies as either holist or serialist. When confronted with an unfamiliar type of problem, holists gather information randomly within a framework, while serialists approach problem-solving step-wise, proceeding from the known to the unknown.

The Allinson-Hayes Cognitive Style Index (CSI) has features of Ornstein's left-brain/right-brain theory. The CSI contains 38 items; each rated using a 3-point scale (true; uncertain; false). Some scholars have questioned the CSI's construct validity on the grounds of theoretical and methodological limitations associated with its development. It is also noteworthy that this measure of cognitive style is both
gender-sensitive and culture-sensitive. While it is entirely plausible that cognitive style is related to these social factors, it does complicate some educational and management issues. It suggests, for instance, that a given student is best taught by a person of a certain sex or culture; or that only persons of certain cultures can work harmoniously together in teams.

1.7 INTELLIGENCE

In education intelligence is the ability to learn or understand or to deal with new or challenging situations. In psychology, the term may more specifically denote the ability to apply knowledge to manipulate one's environment or to think abstractly as measured by objective criteria (such as the IQ test). Intelligence is usually thought of as deriving from a combination of inherited characteristics and environmental (developmental and social) factors. The subject remains hotly debated, and many have tried to show that either biology (especially genes) or environment (especially conditions reflecting socioeconomic class) are more or less exclusively responsible for producing differences in intelligence. Particularly contested have been studies purporting to show links between ethnic heritage and intelligence, most of which have not been accepted in the scientific community. General intelligence is often said to comprise various specific abilities (verbal ability, ability to apply logic in solving problems, etc.), but critics contend that such compartments fail to reflect the nature of cognition and that other models, perhaps based on information processing, are needed. High intelligence (as measured by tests) is sometimes shown to correlate with social achievement, but most experts believe other factors are important and that intelligence is no guarantor of success (and its lack is no guarantor of failure).

Various psychologists have given their own definitions of intelligence as below:

- According to Thorndike (1914) “Intelligence is to make good responses and is demonstrated by thy capacity to deal effectively with novel situation of an abstract, mechanical nature.”
According to Stern (1914) “Intelligence in general is capacity of an individual consciously to adjust his thinning to new requirements. It is the general mental adaptability to new problems and conditions of life.”

According to Vernon (1969) “Intelligence A is the basic potentiality of the organism, whether animal or human, to learn and to adapt to its environment...Intelligence A is determined by the genes but is mediated mainly by the complexity and plasticity of the central nervous system...Intelligence B is the level of ability that a person actually shows in behaviour—cleverness, the efficiency and complexity of perceptions, learning, thinking, and problem solving. This is not genetic...Rather, it is the product of the interplay between genetic potentiality and environmental stimulation...I have suggested that we should a third usage to Hebb’s Intelligence A and B, namely Intelligence C, which stands for the score or IQ obtained from a particular test.

Wechsler (1974) defined intelligence as "the aggregate or global capacity of the individual to act purposefully, think rationally and to deal effectively with his environment."

According to McMillan (1990) “Intelligence means the ability to reason and profit by experience. An individual level of intelligence is determined by a complex interaction between his heredity and environment.”

Intelligence is a descriptive concept. It represents theoretical dimensions which may vary from very low to very high value. In common usage the word intelligence is associated with the general behaviour of an individual so that it becomes synonymous with brightness and being brainy. A psychologist, on the other hand, uses the word as theoretical construct. It is the intervening variable which can be inferred and measured by indirect operations and it has certain descriptive and predicative properties.

In general intelligence conveys three messages:

a) Ability to adjust

b) Ability to learn
c) Ability to carry on abstract thinking

Intelligence must be understood as the mental capacity or mental energy available with an individual at a particular time in a particular situation. So we can conclude intelligence as a sort of mental energy, in the form of mental and cognitive abilities available within an individual which enables him to handle his environment in the terms of adaptation to face novel situation as effectively as possible.

1.8 REVIEW OF RELATED LITERATURE

Related studies are the bases on which the structure of further studies are laid. The model's approach to teaching have received considerable attention since many years and continuous to do so in present situation also in teaching learning process. The review of related literature will help to avoid unnecessary duplication and will guide towards the solution of the problem. The investigator conducted a survey of related studies keeping in view what has already been accomplished in earlier researches; adequate care was taken to avoid duplication of established findings. Suitable extensions and modification were adopted to prosecute new avenues of scope and procedures. Some of the researches related to the variables under the study are presented under the following classifications:

1.8.1 Models of Teaching and Learning

1.8.2 Models of Teaching and Cognitive Styles

1.8.3 Models of Teaching, Intelligence and Retention

Pioneer work in the area of concept learning has been done by Bruner and his associates (1956). Their work 'A study of thinking' culminated many years of research in to the process by which people acquire concepts to examine the learning of concepts. Bruner and his associates had a deal with questions such as 'what is concept?', 'what is meant by knowing a concept?' etc. The major research contributions of Bruner, Goodnow and Austin (1972) deal mainly with the two components of categorization viz. concept formation and concept attainment and types of thinking strategies employed in concept attainment. Most of the research studies in the area of concept learning and teaching are based on the research contributions of Bruner and his associates.
1.8.1 MODELS OF TEACHING AND LEARNING

Sherrish (1980) indicated that deductively sequenced concept related instructional organization enabled meaningful learning of Biology concepts was predicted by their level of prior knowledge, general school ability and the degree to which they completed concept related instructional materials.

Hanclosky (1985) found that the task related group performed significantly higher than advance organizer and concept elaboration groups in both concept and principle learning. An unanticipated out come of age is apparently more important factor in determining appropriate instructional strategies than was previously expected.

Gagnrade (1987) compared the achievement on science of class VIII and class VII students when taught using a combination of concept attainment model and lecture method and then taught through conventional method by taking separately intelligence, attitude towards Science and previous year achievement in Science. He found that the combination of concept attainment model and lecture method was significantly superior to the conventional method of teaching.

Sharma (1987) studied effectiveness of concept attainment and biological science inquiry models for teaching and found significant differences between the gain scores. Biological science inquiry model based teaching was more effective than conventional teaching and concept attainment model.

Chitrive (1988) found that the advance organizer model as well as the concept attainment model was significantly superior to the traditional method, whereas the advance organizer model was superior to the concept attainment model for teaching Mathematical concepts to XI grade students. Prose-passage type and pictorial type advance organizers facilitated the retention of Life Science subject matter even after an interval of four weeks.

D’Lima & Suvarna (1990) conducted a study on the effectiveness of the reception oriented concept attainment model and selection oriented concept attainment model in teaching of Mathematics on VIII grade students of Bombay. The
study revealed that reception oriented model was more effective than selection oriented model in learning of mathematical concepts.

Jaimini (1990) revealed that advance organiser model and concept attainment model as teaching strategies were significantly more effective than the traditional method of fostering conceptual learning efficiency in terms of comprehension and application of concepts in Chemistry. However both the models are equally effective in fostering the concept learning.

Prabhu (1991) studied the effectiveness of the modified concept attainment model, reception oriented model, selection oriented model and traditional method of teaching on the attainment of concept in Geometry. The results of the study showed: (i) All the three instructional techniques i.e. concept attainment model, reception oriented model and selection oriented model were significantly more effective than traditional method of teaching concepts in Geometry. (ii) The modified concept attainment model was significantly more effective than the reception oriented model and selection oriented model.

Gaikwad (1993) studied effect of mastery over theory and planning skills upon teacher-trainees’ performance of concept attainment model. Findings of the study were: (i) Independent reading of instructional material on theory had no significant effect on the teacher – trainees’ acquisition than concept attainment model. (ii) Peer tutoring and mastery learning strategy was found most effective for acquisition of expected mastery level than concept attainment model.

Joshi & Patra (1993) conducted an experiment to study the impact of concept attainment model on general and mental ability of Social Science students. They found the general mental ability mean scores of the students taught through concept attainment model differ significantly from those taught through traditional method.

Chopra (1994) studied the effect of concept attainment model and conventional method of teaching in learning of concepts in English language and found both instructional strategies equally good for teaching.

Suvarna (1994) conducted a comparative study of the effectiveness of the selection oriented and the reception oriented concept attainment models of teaching in
Mathematics to find out the relative effectiveness among experimental groups, namely, selection oriented concept attainment model (SOCAM) and reception oriented concept attainment model (ROCAM) of teaching in Mathematics. Investigator found significant difference between the pretest and the posttest scores of the SOCAM and ROCAM. The performance of the ROCAM was better than the students of SOCAM on both the Pre and Post worksheet performance in Algebra and Geometry.

Gupta (1995) concluded that out of three information processing models of teaching employed for teaching Science concepts. Concept attainment and inductive model were found to be superior to advance organizer model of teaching for teaching to class 9th students.

Ayishabi (1996) made an experimental study in teaching of Zoology through concept attainment model and traditional method at XII level. The study with the post exposure design was conducted. The findings showed that there exists no significant difference in attainment of concepts between the experimental and control groups.

Bala (1997) compared the mean scores on the criterion achievement test in Science of the three groups of pupils taught science with the use of mastery learning strategy, concept attainment model and conventional method of teaching. The findings of the study were, (i) The group of pupils taught Science through mastery learning strategy showed significantly higher gain in achievement than the group of pupils taught through conventional method. (ii) The group of pupils taught through concept attainment model showed significantly higher mean gain scores in achievement than the group of pupils taught through mastery learning strategy.

Mehar (1997) studied effect of advance organizer model and conventional method of teaching on learning and retention and concluded that: (i) No significant difference exists between both groups at immediate and retention level in respect to methods of teaching. (ii) No significant difference was found in the achievement between the field-dependent and field-independent groups at immediate and retention level. (iii) Significant interaction between methods of teaching and cognitive styles was found at immediate level but no significant interaction between methods of teaching and cognitive styles was found at retention level.
Joshi (1998) found that the post-test achievement mean scores of the group of people taught Science through concept attainment model was found to be significantly higher than the group of pupils taught Science through conventional methods. Regarding the effectiveness of teaching through concept attainment model, majority of students (above 70%) strongly agreed that the concept attainment model provided enough scope to think independently. It developed the ability to state the definition of the concept, they could recognize new example, they got a chance of learning from one another and they felt this new method was better than usual teaching method in learning the concept.

Driver (2001) revealed that there exists no statistically significant difference in the two treatment groups, the direct instruction group and the concept attainment group when studied the effects of two teaching models on community college students in an online college Algebra lesson.

Dutt & Kumar (2002) studied the effect of mastery learning strategy on achievement in Economics in relation to cognitive styles and found that achievement through Kelley’s mastery strategy was superior to Bloom’s strategy. In both strategies self-learning model was employed and cognitive styles did not affect achievement significantly.

Kumar (2003) found significant difference of achievement in performance of learners by using different instructional strategies and positive relationship between retention test scores of children with Arithmetic difficulties and their span of attention. There was significant relationship between retention test scores and span of memory.

Culbertson, Daugherty & Merril (2004) examined whether technology education improves students’ achievement scores in the five areas of Reading, Language Mathematics, Science and Social Studies. Investigator concluded that there was no significant difference of achievement between the participants of unit modular technical education and non-participants.

Kalia (2005) studied effectiveness of mastery learning strategy and inquiry training model on pupil’s achievement in Science. The study indicated that inquiry
training model of teaching did not have as much significant impact on Science achievement as mastery learning model.

Singh (2005) conducted a study to compare effect of concept attainment model, advance organiser model and conventional method in teaching of Physics in relation to intelligence and achievement motivation of 9th class students and found: (i) Bruner's concepts attainment model was more effective than advance organiser model and conventional method of teaching with respect to learning of concepts in Physics among subjects. (ii) It was found that the students belonging to high level of intelligence had better performance than the students belonging to low level of intelligence. This study indicated that interaction effect among teaching techniques, intelligence and achievement motivation on scholastic achievement in learning of concepts in Physics does not exist at all.

Wanjari (2005) studied effectiveness of concept attainment model and inductive thinking model of teaching on IX standard students' achievement in Science, scientific creativity and attitude towards Science. The findings were: (i) Inductive thinking model of teaching and traditional method of teaching were found equally effective in developing reasoning ability, scientific creativity and favourable attitude towards Science among the students. (ii) The three groups taught through concept attainment model, inductive thinking model and traditional method of teaching were found to be differing in effectiveness on the achievement. (iii) Concept attainment model and inductive thinking model of teaching are equally effective in terms of achievement. (iv) Concept attainment model and inductive thinking model were more effective than the traditional method of teaching.

Lin, Dwyer & Swain (2006) investigated the effects of advance organisers and audio narrations used to complement animated instruction on tests measuring different educational objectives. No statistically significant differences in achievement were found among the five treatment groups on each of the criterion measures indicating that the type of cognitive strategies employed to complement animation did not instigate deeper levels of information processing and were not effective in facilitating higher order learning outcomes.
Moore (2006) presented learners with definitions, examples and non-examples for selecting evaluation items for judging concept attainment in instructional design. While examples were important presentation instruments and suggested that examples should not be re-used in the assessment phase of instruction. The rationale being that encountered examples could be memorized thus activating different cognitive processes than those required for concept attainment. Consequently, test items referring to encountered examples may have less value in assisting evaluators in discerning whether or not a learner has attained a target concept. There appears to be evidence supporting the notion that examples are not sufficient discriminators for judging a learner’s level of concept attainment.

Faryadi, Zainab, Aminuddin & Hamidah (2007) revealed that students in traditional method of teaching performed marginally but not significantly. Evaluation and questionnaires marked that learner’s perception about content delivery were not as encouraging for the traditional methodology as compare to effective interactive multimedia. Learners were not motivated to learn and continue learning the Arabic language in the class.

Ineke, Driel, Jan & Nico (2007) investigated the effect of teaching models in Science within the context of educational reform in Netherlands. From the results, three different types of teaching models in Science were identified, each of which showed significant change over time. It combined models as an activity undertaken by students with the learning of specific model content.

Churchill (2008) studied learning objects for educational applications via portable digital assistant (PDA) technology. In particular, two types of learning objects were found as appropriate for portable digital assistant delivery: information objects and conceptual models. This preliminary data suggested that learning objects effective for portable digital assistant delivery should be designed as a resource that supports student-centered learning activities, such as inquiries and problem solving.

Naimie, Abuzaid, Siraj, Shagholi & Hejaili (2010) reported in research on the language learning strategies used by a group of Iranian learners. The findings suggest that: (i) The teaching methods should be compatible with language learners’ choice of the language learning strategies. (ii) Language learning strategies should be used to
language learners (regardless of their cognitive style group), in the classroom environment. Secondly,

Ahmed, Gujjar & Ali (2011) compared the effectiveness of concept attainment model and advance organizer model in teaching of English in teacher education course and found: (i) The concept attainment model emerged as effective instructional strategy in teaching of English. (ii) High achiever and low achiever teacher trainees registered better academic performance thought through concept attainment model.

Jadhav (2011) studied the effectiveness of concept attainment model in teaching of Geography to class 8th students. Concept attainment model was found more effective with regard to the objective of knowledge, understanding and application than conventional method of teaching.

Akengin (2011) studied informing 6th grade students on the subject of colour was taught using traditional and computer assisted education methods found that colour knowledge of the students receiving computer-assisted education was higher than the students receiving traditional education and that this same high score is maintained in the retention test applied two months later. statistically significant difference between the scores of the groups taught through computer assisted and traditional methods was found.

1.8.2 MODELS OF TEACHING AND COGNITIVE STYLES

Crisman (1984) studied the concept learning through different techniques and found that students scored significantly better when examples were presented. Sequence was important only in the case of more complex rational concepts where students performed significantly better when the definition and attributes were presented prior to the presentation of examples. There was no significant difference between different styles in concept attainment when the oral and written modes were compared.

Dutt (1987) found that: (i) Intelligence of the problem solver significantly affect the problem solving ability irrespective of strategies of training. (ii) A bright child trained in any of the two strategies scored higher marks on problem solving ability test than a less bright student. (iii) Cognitive styles of a learner was also found
to be significant contributing to the variance of problem solving ability scores, thereby showing that cognitive style affected problem solving ability irrespective of training strategies. (iv) Field-independent group scored more than field-dependent group on problem solving ability.

Hota (1991) studied field dependence and social facilitation and found field independent subjects performed better on mechanical and cognitive measures than field dependent ones.

Behal (1992) studied effectiveness of different models of teaching on acquisition of concepts and attitude towards Mathematics in relation to intelligence and cognitive styles and resulted that: (i) High ability students acquired Mathematical concepts better than average and below average ability students irrespective of models of teaching. (ii) Field-independent students attained more concepts than field-dependent students irrespective of models of teaching. (iii) Cognitive styles and level of intelligence were found to be interactive irrespective of models of teaching on achievement and attitude both. (iv) High ability field-independent students achieved significantly higher scores in Mathematical test concepts than average ability field-dependent students. (v) High ability and field-independent students also scored high marks than high ability field-dependent, average ability field-dependent as well as low ability field-dependent.

Krank (1993) found no significant predictive power for cognitive style or treatment condition. Pre-service teachers’ cognitive styles did not significantly contribute to enhanced critical thinking abilities. No significant differences were found for critical thinking performance between the critical conditions.

Sabine (1993) in his article established the case for making students aware of their own language cognitive learning styles, so that they may gain some control over their own learning processes. The specific focus was on the cognitive styles of field dependence and field independence, which are thought to be most relevant for foreign language learning.
Custer (1994) studied influence of cognitive styles on students’ achievement and indicated that students with strong independent cognitive style showed significant influence on achievement in high school Chemistry.

Moore (1995) studied the relationship between field-independent/dependent cognitive styles of health education college students. He identified no specific cognitive style in health education, pre–medical, physical therapy, occupational therapy, optometry and dental hygiene.

Riding & Rayner (1997) in their paper considered the construct style in the study of individual differences and learning. The origin and elaboration of learning style as a concept was discussed, tracing the influence of cognition and a learning-centered approach to the psychology of individual difference. The authors argued that a contemporary overview of style can contribute to a rationalisation of the theory and facilitate a greater application of learning style in educational practice. A case was made for the need to integrate more fully various models of style into a single construct of learning style.

Hayes & Christopher (1998) reviewed aspects of two largely disparate literatures from the adjacent fields of individual and organisational learning and identified some implications for theory and practice. The focus of attention was the extent to which the individual level construct cognitive style can be meaningfully applied to aid the understanding of learning at the level of the organization as well as at the level of the individual. Attention was given to the ways in which consideration of cognitive style can improve the effectiveness of interventions designed to improve individual and organizational performance. Nine categories of intervention were identified.

Sadler-Smith & Riding (1999) investigated the relationship between learners’ cognitive styles and their instructional preferences. The findings were discussed in terms of models of the cognitive style construct and the practical implications of individual differences in style and preference. There was a significant main effect of wholist-analytical style on collaborative method preference (role play, group discussions and business games) and non-print based media preference (overhead transparencies, slides and videos). There was an interaction of the two dimensions of
style and gender in their effect on informal assessment method preferences (individual and group assignments and multiple choice and short answer type questions).

Mohanasundaram & Kumar (2000) studied hemisphericity and achievement of class 9th students studying History in higher secondary school. Findings were: (i) There was significant difference in achievement between the students with right and integrated hemisphere dominance. (ii) There was significant correlation between right and integrated hemisphere dominance and achievement in History of the students. It inferred that the right hemisphere dominance contributes more to the achievement than the integrated hemisphere dominance.

Gulati (2001) reported significant difference among the achievement of groups of students taught Accountancy through inquiry training model, mastery learning model and conventional method of teaching having different cognitive styles.

Martina (2002) investigated the effect of cognitive style and instructional mode on students' achievement in Biology. The results showed that subjects differed significantly in their post-test achievement scores on instructional mode and cognitive style factors. Of the two-way interactions, instructional mode by cognitive style was significant.

Parkinson & Redmond (2002) studied the impact of three treatments, text, CD-ROM, internet site and student cognitive styles on learning performance. The subject matter was an introductory course in artificial intelligence. It was found that only field dependence-field independence interacted with overall learning performance at a significant level irrespective of treatment. When the three treatments were investigated separately the results suggest that verbalisers performed better than Imagers in the Internet treatment, while the analytics performed better than the wholists in the CD-ROM treatment.

Ehrman & Leaver (2003) presented a new approach to understanding and using cognitive styles to enhance individual language learning and established a learner profile schema usable for diagnosis and advising language learners with ten cognitive style dimensions, most of them well-known (e.g., field independence, leveling-sharpening, random-sequential). The model also included a superordinate
construct, called synopsis–ectasis to avoid confusion with earlier names and constructs like “global-analytic.”

Workman (2003) in his field study examined the influences of cognitive styles on performance and perceived effectiveness of computer-based education delivered from CD-ROM and computer-aided education delivered over the World Wide Web. Significant differences in both performance and perceived effectiveness were found among people with various cognitive styles and their modes of education. People who are able to work with more abstract information (high global) performed better in computer-aided education than people who prefer concrete detail, whereas the converse was found in computer-based education.

Davey (2004) studied field dependent and field independent school-age readers and assessed on reading comprehension question tasks varying in degree of memory load and cognitive restructuring requirements. Field independent readers outperformed field dependent readers on tasks with high memory demands and with requirements for efficient restructuring skills. Field independent subjects were more successful than field dependent subjects on free-response questions under the condition of no-rereading.

Calcaterra, Antonietti & Underwood (2005) indicated that hypermedia navigation behaviour was linked to computer skills rather than to cognitive style and that learning outcomes were unaffected by cognitive style or by computer skills. However, learning outcomes were positively affected by specific search patterns. These findings suggested that the impact of cognitive style on learning outcomes was proved to be less important than initially predicted.

Lee, Cheng, Rai & Depickere (2005) analysed the interaction among the learning dimensions and the effect on students' cognitive styles. The research findings indicated that non-linear learning is the primary dimension that determines students' cognitive styles. The results also confirmed that background information has effects on students' cognitive styles. The overall findings suggest that students' preference of learning dimensions such as linear vs. non-linear, level of learner control and the range of multiple tools must be taken into consideration in order to enrich students' quality of education by means of motivating students' acquisition of subject matter...
through individualise instruction when designing, developing, and delivering educational resources.

Singh (2006) in his study found significant differences in achievement of students of Fine Arts due to different thinking styles. Students having divergent thinking style performed significantly better than the students having convergent and analytical thinking style.

Geetanjali (2007) conducted a study to find the relationship between academic achievement and cognitive styles and revealed that cognitive styles have a significant effect on students’ achievement. Field-independent students performed better than field-dependent students.

North, Ahern & Fee (2007) examined the roles of learning styles and models of teaching within a data mining educational program designed for undergraduate, non-computer science college students. The participants received the lesson through either a direct instruction or a concept attainment teaching approach. It was found that significant difference existed between the scores generated under the two teaching models and within Kolb’s four learning styles. The findings show that the selection of teaching methodology is largely affected by specific learning style group.

Liu, Magjuka & Lee (2008) found cognitive style as one of the important variables to predict individual cognitive functioning. They described an empirical study that examined the role of thinking styles in relation to students' online learning and teamwork performance in an online MBA (Master of Business Administration) program. The evidence suggested that cognitive styles may be a poor indicator of students' overall online learning performance. However, cognitive style had predictive power over the students' satisfaction with their teamwork experience, as well as the level of trust they exhibited in their team members.

Martinez, Chen & Liu (2008) found that cognitive style is an influential factor in users’ information seeking. The study presented in this paper examined how users’ cognitive styles affect their behaviour and perception in digital libraries. Two dimensions of cognitive styles were considered: (i) Field dependence/independence; (ii) Verbalizer/imager. The results showed that intermediate users and verbalizers
have not only more positive perception, but they also complete the tasks in effective ways.

Chen (2009) considered how web-based learning program is utilized by learners with different cognitive styles. This study presented a web-based learning system and analyses learners’ browsing data recorded in the log file to identify how learners’ cognitive styles and learning behaviour are related. In order to develop an adapted Web-based learning system, this study also proposed a design model for system designers to tailor the preferences linked with each cognitive style. The samples comprise third-grade Accounting Information System course students from a technology university in central Taiwan. Analytical results demonstrated that learners with different cognitive styles had similar but linear learning approaches.

Alireza & Abdullah (2010) studied the language-learning styles and language-learning strategies of Iranian Engineering and Political Science graduate students studying abroad. They found that Political Science graduates had major tactile, auditory, group and kinaesthetic learning styles, while engineering graduates had major visual, tactile, group, kinaesthetic and individual learning styles.

Mampadi, Chen, Ghinea, & Chen (2010) in their study developed an adaptive hypermedia learning system tailored to students’ cognitive styles, with an emphasis on Pask’s Holist-Serialist dimension. How students react to this adaptive hypermedia learning system, including both learning performance and perceptions? was examined and findings indicated that, in general, adapting to cognitive styles improves student learning.

Willems, Peelen & Hagoort (2010) found left-hemisphere dominance for language is a core example of the functional specialization of the cerebral hemispheres. The degree of left-hemisphere dominance for language depends on hand preference: Whereas the majority of right-handers show left-hemispheric language laterализation, this number is reduced in left-handers. They assessed whether handedness analogously has an influence upon lateralization in the visual system.

Evans & Waring (2011) studied the relationship between cognitive style and trainee teacher conceptions of differentiation to develop appropriate scaffolding of
their learning. Cognitive style was found to impact on trainees’ conceptions of differentiation and trainees demonstrating higher levels of analysis and intuition had a more developed understanding of differentiation than other cognitive styles.

1.8.3 MODELS OF TEACHING, INTELLIGENCE AND RETENTION

Sohnic (1985) conducted a study to compare the effectiveness of reception and selection oriented models of concept attainment on the twelve grade students of different levels of intelligence with respect to concepts in Mathematics. Major findings of study were: (i) Selection oriented model was found to be more effective than the reception oriented model of concept attainment, with respect to the achievement of the students in Mathematics irrespective of their level of intelligence. (ii) Selection oriented model of concept attainment was found to be more effective than the reception model with respect to the achievement of the students of middle level of intelligence. (iii) Selection oriented and reception oriented models of concept attainment were equally effective with respect to achievement of high and low intelligence.

Sood (1988) found in her study that: (i) intelligence level acted as redundant factor as far as learning of concepts in Hindi language were concerned. (ii) There was no significant difference in achievement scores of field-dependent and field-dependent students. (iii) Cognitive styles and intelligence did not interact significantly to produce differential achievement in Hindi. (iv) Field-dependent students retained more than field-dependent students. (v) High intelligence students retain more than low intelligence students.

Gill (1989) resulted that: (i) high intelligence students scored higher on originality than low intelligent subjects irrespective of training strategies. (ii) The group having field-independent cognitive style scored higher on originality than field dependent group creative problem solving skill test. (iii) Levels of intelligence, personality type, cognitive style and training strategies when paired among them did not show any interaction in terms of performance in creative problem solving skills in Mathematics and cerebral skills.
Bal (1992) found that: (i) The variables of intelligence had a significant effect on acquisition and retention of higher level writing skills in English. (ii) There was a significant effect on retention as measured by test and scores on supply type items but not when measured by scores on selection type items. (iii) Intelligence and cognitive style had non-significant interactional effect on acquisition and retention of higher level of writing skills of English.

Martina (1992) studied the effect of cognitive style and instructional modes on students' retention in Biology. It indicated that field independent students exhibited a very high level of retention while the field dependent group performed poorest on the retention-test. Furthermore, an inspection of the adjusted retention-test cognitive achievement mean scores of the two treatment groups showed that the retention difference between the experimental and control groups was in favour of the experimental group.

Lin (1993) resulted: (i) The performance of subjects can be predicted by linking structure, cognitive style and their interaction. (ii) There was no difference in subjects' recall of verbal information when learning from systems incorporating different linking structures.

Sawhney (1993) found that: (i) Mastery strategy was more effective than other strategy. (ii) Field dependent and field dependent students did not differ significantly in their achievement. (iii) Retention of concept did not differ significantly due to cognitive style difference. (iv) Students taught through mastery strategy retained more than students taught through non mastery strategy, intelligence played important role in retention and retention of Algebraic concepts was not significantly affected by the cognitive styles.

Riding & Pearson (1994) investigated the relationship between intelligence, as measured by the short form of the British Abilities Scales and the holist-analytic and verbal-imagery style dimensions as assessed by the cognitive styles analysis. Near zero correlations between intelligence and the styles was found. A test of embedded shapes was also given and this correlated significantly with intelligence, but not with style. The effect of intelligence and style on performance on a range of school subjects was considered and this showed significant main effects of intelligence and
both of the styles. The results were discussed in terms of the nature of intelligence and cognitive styles.

Bogaards (1996) found intelligence, attitude and interdependence of teaching techniques played significant role to influences language learning when he studied characteristics of student as intelligence, social class and social context-measurable effect on success in foreign language learning at school.

Ojha (1996) studied development of instructional material for teaching Economics to class 9th through concept attainment model in relation to achievement and retention and reported that: (i) The instructional material developed through CAM was found to be effective in terms of student achievement and their reactions towards model (employing the material developed on the lines of CAM). (ii) The mean scores of achievement of students taught through CAM (employing the material prepared on the lines of this model) were found to be significantly higher than those of their counterparts taught through the traditional method at immediate and retention level.

Mishra (1997) found that there was a positive and significant correlation between intelligence levels and academic achievement when it was studied at high school level.

Kohli (1999) studied the effectiveness of self-learning models on achievement in Geography and non-mastery teaching strategies, intelligence and study habits. Self-learning model and intelligence was found to have significant effect on the achievement of students.

Richardson & Turner (2000) addressed a central problem for the theory of field dependence and its relationship with intelligence. Measures of field dependence (e.g. the Embedded Figures Test, EFT) were often found unable to display discriminant validity with conventional intelligence tests. Field independence was often associated with higher intelligence.

Crowe & Barbara (2001) studied relationship between group leader emotional intelligence and students’ retention and suggested that emotional intelligence scores are not significantly related to students’ retention.
Rani (2003) found that: (i) Reception strategy was found superior than selection and traditional strategy, (ii) Traditional teaching proved to be better to acquire Science concepts by low intelligence group, (iii) Low intelligence students showed poor acquisition of concepts taught by selection strategy at formal stage, (iv) Variables of intelligence and cognitive styles did not interact significantly in acquisition of Science concepts.

Kohli (2005) found that: (i) computer assisted model and concept attainment model were found to be effective in improving the achievement level of students, (ii) Computer assisted model and concept attainment model was shown to be very effective in enhancing the emotional intelligence of the students.

Mehra & Mondal (2005) indicated that the high intelligence group taught by teacher directed instruction and followed by peer tutoring performed better in achievement in Science compared to the low intelligence group taught by traditional instruction.

Aruna & Usha (2006) studied the effect of cognitive style, intelligence and classroom climate on process outcomes in Science and found that cognitive style and intelligence have significant positive correlation with process outcomes in Science while the classroom climate has no significant effect on process outcomes in science.

Nicola & Brahm (2007) found that the three groups of pupils with different learning styles showed different gains to teaching that matched these styles. Retention of word spelling was higher one week after the teaching when the teaching matched the learning style.

Vengopal & Mrídula (2007) studied the differences in the right hemisphere and left hemisphere preferences for information processing and found that there is a significant difference in of learning styles among right hemisphere and left hemisphere dominant boys and girls in the preference of concept learning and there is a significant difference in the right and left hemisphere thinking style for information processing in boys and girls.

Jindal (2008) found that: (i) Multimedia presentation and computer assisted instructions were found effective than traditional method of teaching, (ii) Variable of
cognitive style was significantly effective in acquisition of Biological concepts. (iii) No interaction was found between instructional strategies and cognitive styles. (iv) No significant interaction between methods of teaching and cognitive styles and gender was found.

Kalani (2009) studied effectiveness of concept attainment model and conventional method of teaching on achievement at high school and retention of high school level and found: (i) The achievement of students who were taught by concept attainment model was found to be better than conventional method. (ii) Concept attainment model was more effective than conventional method with respect to the scores on attainment on the concept in Science. (iii) Concept attainment model was more effective than conventional method in the retention of concept.

Savoya, Proctorb & Salvendya (2009) studied the effect of power point presentations on student performance. Analyses considered retention of lecture information presented to students without the presence of power point (i.e., traditional lecture), auditory information in the presence of power point and visual (i.e., graphic and alphanumeric) information displayed on power point slides. Students retained 15% less information delivered verbally than the power point presentations. Students preferred power point presentations over traditional presentations.

Alloway, Banner & Smith (2010) investigated the relationship among working memory, cognitive styles and attainment in adolescents using both national curriculum tests and teacher-based assessments. Working memory was found to be the predictor of learning outcomes in English, Mathematics and Science, as well as all teacher assessments. There was also a significant interplay among working memory, cognitive styles and attainment. For students with high working memory, their cognitive styles preference does not impact attainment.

1.8.4 REVIEW OF RESEARCHES

The available review of literature on the present study consists of both empirical studies and conceptual research papers. There are many studies related to variables taken for study in hand. Large number of evidence is available showing the efficiency of the models of teaching over the other techniques of instructions. Many subjects and languages have been taken for testing the effect of different variables on

There have been some studies which show different evidence as models approach is not significantly different than the other approaches of teaching. Studies like Hanclosky (1985), Chopra (1994), Ayishabi (1996), Mehar (1997), Driver (2001), Culbertson, Daughtery & Merril (2004), Kalia (2005), Lin, Dwyer & Swain (2006) and Moore (2006) do not favour the above evidence as these consider no significant difference of effect exists between models approach of teaching and other instructional techniques.


While studying relationship among methods, intelligence, cognitive styles and achievement, there are some studies which found intelligence as an important variable to affect achievement. The studies showing significant differences are Sohnic (1985), Dutt (1987), Gill (1989), Bal (1992), Riding & Pearson (1994), Bogaards (1996), Mishra (1997), Kohli (1999), Mehra & Mondal (2005), Singh (2005) and Aruna & Usha (2006). But studies like Sood (1988) found intelligence level acted as redundant factor as far as learning was concerned.

In the review of literature, the interaction of variables taken in hand was also considered and it was noted that Mehar (1997) found significant interaction between methods of teaching and cognitive styles. Significant interaction between cognitive styles and intelligence was found by Behal (1992), Bal (1992) and Richardson & Turner (2000). Rani (2003) did not found interacting significantly the variables of intelligence and cognitive styles in acquisition of concepts. Jindal (2008) found no interaction between methods of teaching and cognitive styles. Even no significant interaction was found among methods of teaching, cognitive styles and gender. Gill (1989) studied the interaction of methods of teaching, cognitive styles and intelligence and could not find any significant interaction among the three variables.

When literature was reviewed from the point of view of retention of learning, the results found by Chitrive (1988), Kumar (2003), Bal (1992), Sawhney (1993), Kalani (2009) and Savoya, Proctorb & Salvendya (2009) favoured the significant relationship between methods of teaching and retention of learning. In the study of Martina (2002) retention of concepts was significantly related with cognitive styles whereas; Lin (1993), Nicola & Brahman (2007) and Alloway, Banner & Smith (2010) did not found significant relationship of retention of learning with cognitive styles. Sood (1988) found significant relationship between intelligence and retention of learning.

Mehar (1997) and Singh (2005) did not find significant results when studied the interaction between methods of teaching and cognitive styles at retention level. Bal (1992) and Alloway, Banner & Smith (2010) found significant results when studied the interaction between cognitive styles and intelligence at retention level. Crowe & Barbara (2001) found intelligence scores are not significantly related to students’ retention.
Most of the researches have compared two or three methods of teaching to acquire some objectives considering a particular subject or topic. The previous researches in the field of pedagogy of teaching have established beyond doubt that no single method is suitable to teach all subjects, all topics or even a particular topic. Two points have clearly emerged, one that there was no study on the subject of Punjabi and secondly there was no agreement on the relationship of models of teaching, cognitive styles, intelligence and performance retention. Hence, there was a case for studying these variables in relation to Punjabi.

1.9 NEED AND SIGNIFICANCE OF THE PROBLEM

In this 21st Century where English medium schools are prevalent and education of these schools have been focused on public demand, as perhaps never before, on the important role that schools serve in educating students for a technological world. Experts in the educational field have for long realized the shortcomings of traditional classroom teaching. It is felt necessary that learning should be effective in enabling students to apply newly learned concepts in new situations. Increased emphasis is being placed on the development of concepts. According to current conceptual system, the learning of concepts is of utmost importance for students as they learn and communicate with the help of 'concepts'. The acquisition of knowledge is possible only through concept learning because knowledge is a chain of concepts. Bruner's concept attainment model aims at improving the teaching method and teaching-learning process. It is expected that the present study will highlight the need to know the role of different cognitive styles and importance of different strategies in teaching of Punjabi. Teachers can use this information to change their lessons from lecture and note-taking instruction to active involvement that enhances students' comprehension.

However no attempt has been made, so far, to analyse the effectiveness of concept attainment model on achievement in Punjabi language. The investigators’ experience and awareness regarding the methodology of teaching exists in the college of education convinced him that there is a felt need to change the method of Punjabi instruction in respect of cognitive styles and intelligence. Any meaningful attempt to evolve a new strategy of teaching will be a great help and remedy to the present
monotonous system of instruction. With the help of this research we will be able to solve the questions like: (i) How education providers can cater more for individuals having different levels of intelligence? (ii) How can universities and colleges encourage their students to become more effective in their thinking processes? The conclusions from the study will have important implications for day-to-day classroom teaching to achieve various purposes. The text books of Punjabi can also be modified accordingly. It is further felt that pre-service and in-service teacher training programmes also lack training in models of teaching. This research will also help the teachers, parents, guidance workers, counselors, principals, curriculum framers and government to make an appropriate planning for future generation. It will be able make the teaching process interactive, lively and interesting.

Reiff (1992) gave several reasons for such kind of researches: (i) Reduction of teacher and student frustration. (ii) Higher student achievement and an improved self-concept. (iii) Accommodation of a variety of learners in a classroom. (iv) The versatility that is crucial to learning and (v) Improved communication with administrators, parents, counselors, and other staff. For these reasons cognitive, affective, and physiological learning styles are considered.

1.10 STATEMENT OF THE STUDY

**EFFECT OF BRUNER’S CONCEPT ATTAINMENT MODEL ON LEARNING AND RETENTION IN PUNJABI IN RELATION TO COGNITIVE STYLES AND INTELLIGENCE**

1.11 DELIMITATIONS OF THE STUDY

The study was delimited with regard to following aspects:

(i) The study was conducted on 9th class students of Punjabi only.

(ii) Students were taken from four high schools of Abohar city of district Ferozepur in Punjab only.

(iii) Twenty lessons based on concept attainment model were prepared in Punjabi grammar only.
1.12 OBJECTIVES OF THE STUDY

The study was designed to attain the following objectives:

(i) To develop the instructional material based on concept attainment model for selected units of Punjabi grammar.

(ii) To develop a test to measure the achievement of students in selected units of Punjabi grammar.

(iii) To compare the achievement of groups taught through concept attainment model and conventional model of teaching at immediate and delayed scores.

(iv) To compare the achievement of groups having different cognitive styles at immediate and delayed scores.

(v) To compare the achievement of groups having different intelligence levels at immediate and delayed scores.

(vi) To study the interaction effect of the models of teaching and cognitive styles at immediate and delayed scores.

(vii) To work out the interaction effect of the models of teaching and intelligence levels at immediate and delayed scores.

(viii) To find out the interaction effect of the cognitive styles and intelligence levels at immediate and delayed scores.

(ix) To work out the interaction effect of the models of teaching, cognitive styles and intelligence levels at immediate and delayed scores.

1.13 HYPOTHESES OF THE STUDY

The study was designed to test the following hypotheses in respect of immediate performance and retention.

Immediate achievement

$H_0$ The achievement of group taught through concept attainment model will be significantly higher than that of the group taught through the conventional model of teaching on Punjabi grammar.
H₂O There exists no significant difference in means of achievement scores of different cognitive styles.

H₃O The achievement of groups having different intelligence levels will be significantly different from one another on Punjabi grammar.

H₄O There exists no significant interaction effect of models of teaching and cognitive styles.

H₅O There exists no significant interaction effect of models of teaching and intelligence.

H₆O There exists no significant interaction effect of cognitive styles and intelligence levels.

H₇O There exists no significant interaction effect of models of teaching, cognitive styles and intelligence levels.

Retention

H₁O The retention on Punjabi grammar of groups taught through concept attainment model will be significantly higher than that of the conventional model of teaching when measured after an interval of 30 days.

H₂O There exists no significant difference in means of retention scores of different cognitive styles when measured after an interval of 30 days.

H₃O The gain retention of groups having different intelligence levels will be significantly different from one another on Punjabi grammar when measured after an interval of 30 days.

H₄O There exists no significant interaction effect between models of teaching and cognitive styles on retention after an interval of 30 days.

H₅O There exists no significant interaction effect of models of teaching and intelligence levels on retention after an interval of 30 days.

H₆O There exists no significant interaction effect of cognitive styles and intelligence levels on retention after an interval of 30 days.

H₇O There exists no significant interaction effect of models of teaching, cognitive styles and intelligence levels on retention after an interval of 30 days.