Chapter 3

CONCEPTUAL FRAMEWORK
CHAPTER-III

CONCEPTUAL FRAME WORK

3.1 INTRODUCTION

For the study to be significant and productive it is imperative to present a conceptual framework. Conceptual Framework enables the researcher to approach the problem in a specific, systematic and scientific manner.

Since time immemorial, the activity of teaching has been used in one form or other for the transmission of knowledge and skills. In order to achieve the desired success in any teaching-learning process, the role of the teacher can never be minimized. In fact, much depends on the competency and capability of the teacher for carrying out the desired task. Not every body can be entrusted with the crucial task of behaviour modification and personality development of a number of children studying in a class or school. One has to make oneself capable by equipping oneself for it. Students have multi dimensional personalities and different learning styles with numerous individual differences. There are many methodologies and strategies of teaching which could serve as guiding principles for creating a teaching environment. But there is no definite method or particular set of teaching strategies prescribed to match the environment in Indian classrooms especially for primary children. The educational policy of the Government of India lays stress on activity based approach and child centred approach of teaching for joyful learning. A well planned activity based teaching strategy developed by an effective teacher will reveal itself to be child centred. Thus teaching learning process becomes joyful and meaningful.
3.2 LEARNING

Learning is that which happens in an individual when he acquires a new pattern of behaviour or modifies his old behaviour. Learning provides a key to the structure of our personality and behaviour.

Learning is an active process in which the learner himself is directly involved. Although the teacher cannot do the actual learning for the pupil, he can facilitate learning through effective teaching. Effective teaching and learning demand mutual understanding between the teacher and the learner.

According to the mind theory (Christian Wolff, 1734), all learning represents some activity on the part of the mind. The activities of the mind express themselves through the use of the sense organs and through the exercise of memory, imagination, will, judgment, and reasoning. In other words, all learning is training of the mind and developing the powers of its faculties, such as reasoning, perception, memory and the like.

Connectionist’s theory refers to the famous stimulus-response (S-R) bond theory of learning advanced by Thorndike. According to this theory learning occurs through a change in the connection between a particular stimulus and a response. Man’s learning is fundamentally the action of the law of readiness, exercise and effect.

In the application of this theory in teaching, the teacher and the learner must know the characteristics of good performance in order that practice may be appropriately arranged.

Learning, from the behaviorist’s point of view, refers to the building up of conditioned reflexes or the habit formation resulting from conditioning. According to Watson, “condition reflex is central to learning as the unit out of which habits are formed. “Watson used Pavlov’s experiments
as the epitome of learning and mode of the condition reflex as the unit of habit, and built his system on that foundation.

Behaviorists assume that all human learning should be studied in terms of observable behaviour without any reference to consciousness. To them learning is any change in the behaviour of the organism. Such change may range from the acquisition of knowledge, simple skill, specific attitude and opinions. A change in behaviour or in a response means the formation of new bond, and vice versa. The task of a teacher is to provide a situation which offers constancy of stimulation sufficient to form bonds and habits, and to provide for the adequate practice of these.

According to integration point of view learning is considered as the acquisition of knowledge, abilities, habits and skill through the interaction of the whole individual with his total environment or situation. Learning is self-motivated and the learning process proceeds best when the numerous and varied activities utilized by the learner are unified around a central core. The central core, to them, gives meaning to the activities.

Integration point of view is based on the Gestalt Theory of learning or Field Theories. This point of view recognizes that the whole is more than the sum of its parts, or that the whole gets its meaning from the parts.

According to progressivist’s point of view it is impossible to compartmentalize the individual and train each part separately. The learner reacts as a whole and in a unified way. This means that all the various parts of the behaving organism cooperate, part by part, to serve the needs of the organism.

It calls for active doing, physically, mentally and emotionally. It consists chiefly of doing, feeling and thinking the actual thing to be learned.
Therefore learning is conceived in terms of the total growth of the child rather than the mastery of subject-matter or change in behaviour.

3.2.1. PROCESS OF LEARNING

According to the psychologists, the learning process of the higher animals and human beings follows the same general type and is subject to the same principles. Human beings differ from animals only in the degree of learning— that the human being learns more rapidly, retains more, masters more complex functions, and utilizes ideas to a greater extent.

Trial and error learning is one of the learning process, and it can denote attempts at meeting the ways in various ways until the correct responses are found more or less accidentally. The activities for trial and error help to stimulate the thinking power of the pupils so that they can discover for themselves those relationships that serve their learning purpose.

Learning by conditioning is changing the meaning of a situation by associating it with same past experience of new stimuli that brings about satisfaction or dissatisfaction to the learner through the agency of repetition.

Learning by observation and imitation is the process which directs the attention to those specific elements considered worthy of mental record and reproduction. The children begin to imitate very early in life, their ability to learn by means of imitation increases rapidly as they grow older.

People do not always resort to pure random experimentation of the trial and error kind when confronted with a problem to be solved. Instead, they show evidence of what has been often called insight; that is, their immediate reaction is to observe the qualities of the objects rather than the objects themselves. In this form of learning insight or ideas assist in mastering the mechanical or mental solution.
3.2.2 MENTAL PROCESSES IN LEARNING

Learning does not take place directly or instantaneously. Various processes happen in the mind before a concept is formed. The stimulus or motivation supplied to any one of the five senses triggers the observation which in turn leads to perception or understanding. Images are formed and stored in the mind which facilitate memory. Sooner or later when the same images are provided, they bring back to mind or help to remember the perceived ideas or object. Remembrance associates our thoughts with sights, sounds or ideas, which result in imagination. The working of the mind does not stop with imagination. It sorts out and discriminates the ideas framed through imagination and generalizes them into a particular concept. All these cannot be thrust into the mind within a short period. When they are allowed to happen step by step the child can understand a concept clearly without any confusion or misunderstanding. That is why it requires a lot of time, planning and preparation on the part of the teacher to teach a concept.

Sensation
Observation
Perception
Image formation
Memory
Thinking
Association
Imagination
Discrimination
Generalization
Concept formation

3.2.3 STAGES OF LEARNING

Children who struggle with their school work at primary level show three patterns in their learning. They learn inefficiently, inconsistently and incompletely.
Complete learning, that stays with us for long periods of time, takes place in steps, or stages. At each of these steps, which are called the Four Stages of Learning, we master a task a little more thoroughly, until we finally know it extremely well. They are Exposure Stage, Guided Learning Stage, Independence Stage and Mastery Stage.

a. Exposure Stage

Exposure Stage is encountered when a concept is completely new to the learner at any time.

b. Guided Learning Stage:

Stage two is called the guided learning stage because the children still can’t do the problems without help and guidance from the teacher. They begin to catch on though and with support, encouragement and clues from the teacher, they can attempt the problems. But it is hard work and since they make a variety of mistakes they need the teacher’s help often. They are dependent on the teacher for success. So complete learning does not take place. If a student stops at this level and doesn’t progress to the independence Stage he hasn’t really learned anything useful.

c. Independence Stage:

With review guidance and hard work, children reach stage three called the ‘independence stage’. At this stage, they can do most of the problems on their own, most of the time. This is when they begin to think of the task as easy and they gain confidence in their abilities.

However, if the pathway for a skill weakens they may drop back to the Guided Learning Stage. Once again they are unable to do the work independently. This is why the elementary school math text books begin the school year with a thorough review of the last year’s skills. The review maintains independent skills and prevents the students from slipping back to stage two.
d. Mastery Stage:

The final level or the Mastery Stage comes with still more practice. At this stage, the children learn to do the problems thoroughly and completely. They can perform it for the rest of their lives with no clues, no help or review. Their understanding of it is automatic and they can do the steps without stopping to think what to do next.

At this stage, children know the information without thinking. However, we would need occasional review or eventually they might forget (perhaps only partially) how to do the problems. Mastery is the final goal of Education.

3.3. LAWS OF LEARNING

As we study the learning process and the way in which children and adults learn, we are able to see certain principles or laws which are usually followed when people learn. We cannot claim that these laws are followed every time anything is learnt by a child. But if these principles are followed, then learning will be more satisfactory, and the results of work will be much better. A knowledge of these laws of learning help us a great deal in planning our lessons and makes school work easier and more pleasant both for the teachers and the children.

3.3.1 Law of Readiness

Learning takes place best when a person is ready to learn. When a stimulus is present then learning follows naturally. When a person is ready to act, acting gives satisfaction, and being prevented from acting causes dissatisfaction. If a person who is not ready to act is not stimulated, and if he is made to act, it causes dissatisfaction.
A small boy is always ready to play. When the teacher inform the group of children that they are going to have a game. In doing so, he stimulates the class. They are ready for action. In order to play the game it is necessary to have some things ready, such as some sticks which may have to be cut, or some words have to be written on pieces of cardboard. Because of the children’s readiness to act, they eagerly do what has to be done, even though there may be a little delay in carrying out their purpose while they learn to make properly whatever has to be made. They learn because they are ready to act.

In discussing this law of readiness, the term ‘mind-set’ is used. It means a general readiness of the person for a certain type of activity. The readiness for one particular action, is the result of a mind-set. Mind-set is broader and more general than readiness. For example, when we have a mind-set to pass a certain examination, we will be ready to learn various subjects in which we have to pass if we are to pass the examination as a whole.

3.3.2. Law of Maturation

There are periods during the development of children, when they are ‘ready’ for learning different subjects and skills. At such periods, training and instruction produce very rapid gains in learning as compared with other periods. Periods of rapid learning are usually the result of some aptitude approaching maturity at that time. It follows then that when we give our pupils work to do, it should be given according to their degree of maturity in mind. A great deal of experimenting needs to be done in this country to find the times of maturity for different subjects and skills. We probably try to teach ordinary arithmetical processes at too early an age. But as far as our knowledge goes we should take into account the readiness provided by maturation.
3.3.3. Law of Purpose

The stronger a person’s purpose to do a thing, the greater is his readiness to learn what is connected with carrying out his purpose, and the greater his lack of readiness to do anything that is not connected with achieving his purpose. If they are carrying out a purpose, or wish to carry out a purpose which they really feel and appreciate, then they will be really ready for acting and learning. The more we can utilize the purposes of our children, the more satisfactory will our work be to ourselves and to our children.

3.3.4 Law of Exercise

We learn what we practice. We do not learn what we do not practice. If we wish our children to learn properly we must give them opportunities of practising or establishing the connection between stimulus and response. When the child has first learned that four times three are twelve, he has to think and try to remember when he is again asked what four times three are. Gradually, if we give the child enough opportunities for repeating this line of thought, of making this response, his answer becomes automatic, and we say he has learned his table. Similarly with action, we learn to master our environment only by repetition.

3.3.5. Law of Satisfaction

We learn to do things that bring satisfaction, and we learn not to do things which bring us annoyance. In other words, the connection between stimuli and response becomes strong when we get satisfaction from the responses, but remain weak when we get annoyance from the response. The teacher will have to take measures according to the individual natures of his children and according to circumstances. But he must always remember that work done in the right way should bring with it satisfaction, and that work done wrongly should bring feelings of dissatisfaction. Only then learning will take place along right lines. There is no need to point out how important this
is in the primary school stages where so many habits are being formed, since so much in the future life of the child depends on a good start.

3.3.6. Law of Selection

While learning, if there are a number of responses open to a child, he will adopt that which brings him satisfaction, that is, the course of action which, as far as he can judge, will best help him to fulfill his purpose of the time. This selection is determined by the previous law, the law of satisfaction. It is the teacher’s task to help the children to select the right response, so that learning may take place more quickly than by a continual process of trial and error. The child must learn to use his intelligence in selecting his response and the teacher will help him to do this.

3.3.7. Law of Association

When we are learning, new ideas tend to become associated with the ideas already present in the mind. When an idea comes into the mind this connection which is established between ideas results in the “calling up” of other ideas with which the first idea has been associated or connected. We have already seen the importance of linking up new knowledge with the knowledge already possessed by the child, when teaching. If we can help the child to associate ideas, or in other words, to organize his knowledge, we will be helping him to learn and to recall.

(a) Association by contiguity: Ideas tend to be connected which occur together. The thought of a book is immediately followed by the thought of the author.

(b) Association by similarity: We tend to think of a person and are reminded of some one who looks very much like him.

(c) Association by contrast: We tend to think together of things which are opposite to each other.

(d) Association of cause and effect: When we think of a cause we then think of the result and perhaps the vice versa.
3.3.8. Law of Recency

This is another way of stating what is sometimes called the law of disuse, which is simply that if we do not use what we have learned then we tend to forget it.

If a boy learns that four times three is twelve, and then this is not used and not practised, he will soon forget it. He remembers those things which are recent in his experience. This means that until knowledge becomes habitual we have to give regular opportunities for revising it and making it recent. Hence in our teaching work frequent revision is very necessary.

3.3.9. Law of Transitoriness

There are certain times at which certain interests are prominent, or, as we can say, when certain instinctive tendencies show more strongly than at others. If we do not take advantage of these times the interest tends to disappear.

From eight or nine years of age to twelve years or so, the herd instinct is very strong and we have what we call the ‘gang’ period. The boy of this age, is a keen wolf cub. This is an example of how the emergence of an instinctive urge can be used for the purpose of learning. If this opportunity is missed, the child will lose a great deal. Later through team games the tendency to cooperate can be used.

3.3.10. Law of Multiple Learning

We never learn just one thing at a time. We always learn a number of things together. This is sometimes called the law of concomitant learning.

During school hours the child is not simply learning the things which come in the lesson. He is also learning from the character of the teacher, from the teacher’s attitude to his work and to his children, from his words, and from
his action, learning perhaps things which would astonish the teacher if he realized them.

It is very important for the real success of our work, and for the future of our pupils, that we keep this law constantly in mind, and do our best to see to it that the concomitant learning of our children will help them to develop into good and cultured citizens.

3.4. MEANING AND CONCEPT OF TEACHING

Teaching is a social act whereas learning is a self act. Even without a teacher the learner can learn. Teaching is defined as making known to others. It must be a two-way process. There must be interaction between the teacher and the learner. Teaching is a ‘process’ which refers to the multiple tasks carried out by the teacher for leading the learners to the expected learning. The multiple tasks include that he scribes, narrates, explains, answers a question, supervises students work, corrects students responses and so on.

According to Morrison, H.C. (1934) “Teaching is intimate contact between a more mature personality and a less mature one, which is designed to further the education of latter”.

Brubacher, J (1939), “Teaching is an arrangement and manipulation of a situation in which an individual will seek to overcome and from which he will learn in the course of doing so”.

Hughes, MM, (1963) “A description of teaching as it was in progress in the classroom could be secured by defining ‘teaching as interaction! Interaction is used in its dictionary sense of mutual or reciprocal action or influence.

Gage, NL (1963) “By teaching we mean….interpersonal influence aimed at changing the ways in which the other person can or will behave”.

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According to Burton, "Teaching is the stimulation, guidance, direction and encouragement of learning". Teaching will be more effective if this definition is followed carefully. Teaching is the stimulus and learning is the response or reaction. Learners should respond to the teaching. If the responses are satisfactory and favourable then we can safely conclude that teaching has become very effective and the learners are benefited by it. The quality of teaching done by the teacher is related to the quality of learning attained by the pupil. Better teaching should always bring about better learning and better learning always shows better teaching.

To make teaching and learning more effective, the teacher's aim must be clear. The materials of instruction must be adapted to suit the pupils' interests and needs; the school environment must be conducive to learning; and the pupils must be in the best physical and emotional condition to receive the instruction offered. Their previous knowledge, skills and experience are to be tested and it should be ascertained whether the learners are in a position to learn or understand the contents given by the teacher. Otherwise teaching becomes a waste. Successful teaching depends on the achievement of the learners.

The mode of presentation of the contents to the learners depends mostly upon the methods which the teacher follows. So it is necessary to plan beforehand what methods should be followed for effective and good teaching. Effective teaching will have a lasting effect on the minds of the learners.

A favourable attitude towards mathematics and mathematics teacher is needed for effective teaching of mathematics. Actually, attitude has its bearing on students, teachers, their performances, etc., and so the teachers of mathematics must create a favourable attitude among the learners, towards the subject-matter and teaching. Favourable attitude of the students will not only
help the students learn the subject matter, but also will make teaching an ever enjoyable activity and will ultimately enrich the teaching of mathematics.

3.5. THEORIES OF TEACHING

Teaching theories are concerned with appropriate techniques for attaining educational objectives. The Pre-active stage (planning, preparation, deciding learning outcomes etc), the interactive stage (face to face teacher – pupil contact) and the post-active stage (Evaluation ) are the three stages in any teaching act. Theories of teaching also reveal different aspects of teaching.

The Malentic theory of teaching which is Socratic in character postulates three steps – disillusionment which asks the learner to recognize what he believes to be true is false, leading the learner to recognize that certain prepositions are true and assisting the learner to recall why these propositions are true. The Communication theory speaks of the teacher as the transmitter of the desired information to the learner. The Moulding theory of teaching is based on the principle of conditioning which implies teacher manipulation of certain appropriate stimuli so as to form preferred habits. The Mutual Enquiry theory looks upon the teacher’s role as that of assisting and guiding the learner as a more mature and experienced partner. Carl Rogers (1967) speaks of the importance of the inter-personal relationship between teacher and pupils resulting in a good class room climate. Teachers should treat pupils with genuine positive regard, sympathy and honesty.

3.5.1. The Constructivistic Theory

The basic premise of the constructivist theory is that an individual learner must actively “build” knowledge and skills (Bruner, 1990) and that information exists within these built constructs rather than in the external environment. However, all advocates of constructivism agree that it is the individual’s processing of stimuli from the environment and the resulting cognitive structures, that produce adaptive behaviour, rather than the stimuli themselves
(Harnad, 1982). John Dewey (1933/1998) is often cited as the philosophical founder of this approach; Ausubel (1968), Bruner (1990) and Piaget (1972) are considered the chief theorists among the cognitive constructionists, while Vygotsky (1978) is the major theorist among the social constructionists. Activity theory and situational learning are two examples of modern work based on the work of Vygotsky and some of his followers.

A major theme in the theoretical framework of Bruner is that learning is an active process in which learners construct new ideas or concepts based upon their current/past knowledge. The learner selects and transforms information, constructs hypotheses, and makes decisions, relying on a cognitive structure to do so. Cognitive structure (i.e., schema, mental models) provides meaning and organization to experiences and allows the individual to “go beyond the information given”. The teacher should try and encourage students to discover principles by themselves. The instructor and student should engage in an active dialog (i.e., Socratic learning). The task of the instructor is to translate information to be learned into a format appropriate to the learner’s current state of understanding. Curriculum should be organized in a spiral manner so that the student continually builds upon what he has already learnt.

Bruner provides the following principles of constructivist learning:

1. Instruction must be concerned with the experiences and contexts that make the student willing and able to learn (readiness).

2. Instruction must be structured so that it can be easily grasped by the student (spiral organization).

3. Instruction should be designed to facilitate extrapolation and or fill in the gaps (going beyond the information given).

Bruner (1966) states that a theory of instruction should address four major aspects: (1) predisposition towards learning, (2) the ways in which a body of knowledge can be structured so that it can be most readily grasped by the learner, (3) the most effective sequences in which to present material, and (4)
the nature and pacing of rewards and punishments. Good methods for structuring knowledge should result in simplifying, generating new propositions, and increasing the manipulation of information.

Bruner cites the following example (1973):

"The concept of prime numbers appears to be more readily grasped when the child, through construction, discovers that certain handfuls of beans cannot be laid out in completed rows and columns. Such quantities have either to be laid out in a single file or in an incomplete row-column design in which there is always one too few to fill the pattern. These patterns, the child learns, happen to be called prime. It is easy for the child to go from this step to the recognition that a multiple table, so called, is a record sheet of quantities in completed multiple rows and columns. Here is factoring, multiplication and primes in a construction that can be visualized."

On the whole Jerome Bruner argues that instructional theories should emerge out of the awareness of “internal Cognitive changes in the pupils as a result of purposeful classroom teaching”. Bruner emphasizes the importance of “activity based teaching” and “discovery learning” by pupils in which new information and skills are integrated with the previously learned material.

3.6. METHODS OF TEACHING MATHEMATICS

There are a variety of methods and techniques available in the teaching of Mathematics. The selection of a suitable method depends upon the objectives of the lesson, needs of the learner and the nature of the content. Teaching of Mathematics in the primary level classes should be based on activity based teaching strategies where the teacher is expected to follow one or more than one method in order to make the teaching efficient. Some of the prominent methods applicable for teaching elementary level mathematics are given below.
3.6.1. Project Method

This method is developed and applied practically by Kilpatrick. The exponents of this method are of the opinion that knowledge turns into power only through application.

According to Kilpatrick ‘A project is a unit of wholehearted purposeful activity carried on preferably in its natural setting’.

Ballard defined project ‘as a bit of real life that has been imported into the school’.

In project method, teaching and learning are considered from the child’s point of view. Knowledge and skills are learnt by pupils through practical handling of problem in their natural setting. This method is an ideal way of promoting creativity, arousing curiosity and inculcating the spirit of enquiry among the students.

Learning by doing, learning by living, and learning better through association, cooperation and activity are the basic psychological principles of project method. This method is based on the psychological laws of learning namely, the law of readiness, the law of exercises, and the law of effect. It also involves certain steps like, providing a situation, selecting and purposing of the project, planning of the project, executing the project, evaluating the project and recording.

3.6.2. Heuristic Method

This method was advocated by Armstrong, who felt that by placing the student in the position of a discoverer, he would learn much more than being merely told about things. The student discovers facts and information,
relationships and principles for himself. This method is based on the principle of learning by doing.

This method has certain primary objectives like, inculcating in the student the habit of enquiry, to enable the children to listen, to observe, to ask and to discover. This method enables the children to be more exact, observant and thoughtful. It lays a solid foundation for future self-learning and inculcate the spirit of scientific enquiry.

3.6.3. Inductive Method

It is a method of arriving at a formula or a rule by observing a sufficient number of particular instances. We proceed from particular to general, from concrete instances to abstract rules and from simple examples to complex formulae. It is found to be very suitable for the teaching of mathematics because many mathematical formulae and generalizations are the results of induction.

This method involves a number of steps such as the selection of a number of cases, observation of the case under given conditions, investigation and analysis, finding common relations, arriving at generalization, and verification or application.

The inductive method helps understanding, and develops critical thinking. It is a logical method which encourages active participation of the students in learning. It provides ample opportunities for exploration and observation. Proceeding from known to unknown helps retention in memory. It curbs the tendency for rote learning, facilitates meaningful learning and develops self confidence among the children.
3.6.4. Deductive Method

It is the opposite of Inductive method. Here the learner proceeds from general to particular, abstract to concrete and formula to examples. A pre-constructed formula is given to the students and they are asked to solve the relevant problems with the help of that formula.

3.6.5. Laboratory Method

In laboratory method children are required to do some experiments or carry out certain activities in order to verify the validity of a mathematical generalization, a law or a statement. It is the experimental portion of the inductive method or the practical form of the heuristic method. Therefore in this method one proceeds from concrete to abstract. It is based on the psychological principles of learning such as 'learning by doing', 'learning by observation' and so on. Laboratory method is quite competent to relate the theoretical knowledge with the practical base. This approach makes the learning process more interesting, lively and meaningful. Psychological laws of learning such as law of exercise and law of effect are involved in this method.

This method stimulates the interest of the students to work with concrete material. It also provides an opportunity for the students to work with concrete materials to understand abstract ideas. It provides experiments for better understanding and longer retention. It promotes self-confidence and self reliance by providing opportunities for social interaction and cooperation among the students.
3.6.6. Problem Solving Method

Problem solving method begins with the statement of a problem that challenges the students to find a solution. The problem centers around the subject matter under study and requires the use of information and skills available to the students. In the process of solving the problem, the students may be required to gather data, analyse and interpret the information to arrive at a solution to the problem. It is presupposed that a problem exists in the teaching-learning process, that there is an obstruction of some sort to the attainment of an objective. It may be a physical or mental difficulty which does not enable the individual to reach a goal easily. The children recognize it as a challenge. Hence in the problem solving method the teacher and the student attempt a planned manner of finding a solution to a significant difficulty. This is a device which provides ample opportunity for mental activity.

3.6.7. Demonstration Method

In this method, the teacher performs the experiments before the class and simultaneously explains what he is doing. It leads the students from concrete experiences to abstract concepts. It trains mental faculties such as the power of observation, reasoning and drawing inferences.

3.7. MODELS OF TEACHING

Models of teaching are plans, patterns or blue prints which present the steps necessary to bring about a desired outcome. According to Joyce and Weil (1982), a teaching model is a pattern or plan which can be used to shape curriculum or course, to design instructional materials and to guide a teacher’s actions. A model of teaching provides guidelines for designing educational
activities and environment. It specifies ways of teaching and learning that are intended to achieve certain kinds of goals.

Models of teaching are a midway approach between teaching method and teaching skill approach, i.e. it is the teaching process approach. It creates the necessary environment which facilitates the teaching process. The models of teaching have three major functions in the teaching-learning process. They play an important part in the designing of the curriculum or courses of study, assist in the development and selection of instructional materials and guide the teacher's activity in the teaching learning process.

Joyce and Weil classified models of teaching into four families that represent distinct orientations toward people and how they learn. The family of Information Processing Models is the way people handle stimuli from the environment, organize data, sense problems, and generate concepts and solutions to problems, and employ verbal and nonverbal symbols. Personal Models share an orientation towards the individual and the development of self. They emphasize the process by which individuals construct and organize their unique reality. They are more concerned with human feelings and emotions. Social Interaction Models emphasize the relationship of the individual to society or to other persons. They focus on the development of capabilities for interpersonal relationships.

3.7.1. Concept Attainment Model

This model belongs to the family of information processing models. It is a class room teaching model useful for teaching concepts. The approach is inductive. The basic steps, as in any lesson are:
a) Planning activities,

b) Implementation of activities, and

c) Evaluation.

The following steps are involved in planning activities: identification of goals, selection of examples, sequencing of examples, and selecting the appropriate medium for presenting the examples (i.e., pictures, models, specimens, etc). The implementation of activities involves presentation of examples (in the proper sequence) and the analysis of characteristics. The final step in implementation stage is ‘closure’ that results in the definition of the concept and the giving of additional examples, etc. At the evaluation stage, the attainment is tested.

This model follows the naturally occurring process of concept formation, finding similarities, forming categories and abstraction.

3.7.2. Inductive Thinking Model

The focus of this model which belongs to the information processing family is on developing mental abilities and emphasizing concept formation involving cognitive tasks. According to Hilda Taba (1967), “The subject matter has to be seen as consisting of three levels of knowledge; each of which served special function in curricular organization, and thus, specific plans are needed for selecting organizing the learning experiences through which the students could achieve several different objectives, such as discovering important ideas, mastering relevant skills and developing attitudes: attention and the like to the kind of teaching strategy required by a successful pursuit of these objectives”. 
3.7.3. Inquiry Training Model

Inquiry training model is helpful in inculcation of scientific temper among students. This model assumes that the students can be encouraged to increase complexity of their intellectual structure.

In this model, the students are presented with a puzzling problem/situation or event but it should not be bewildering. For getting clues to the problem solution, the students ask the teacher questions that are answered in affirmative or negative (‘yes’ or ‘no’). Students gather in a simulated process and then explain this discrepant event. The inquiry training model has three phases – encountering with the problem, inquiring through questions, verbal or actual experimentation including formulation of hypotheses and analysis of inquiring strategy. The model has been developed to teach confrontation, verification and experimentation, investigating and explaining unusual phenomena.

3.8. TEACHING STRATEGIES

The word “strategy” denotes planning and directing of large-scale military movements or operations. In the general sense, ‘strategies’ refer to managing the means or methods to reach a goal. Historically in education, the term “strategy” has been used synonymously with the terms “method” or “procedure” (Smith 1976). It refers to a set of teaching actions intended to attain the desired outcome. Other pedagogical definitions of strategy refer to the sequencing of events and extended substantive exchanges among teachers and pupils (Dunkin and Biddle 1974). Therefore, teaching strategy is the sequence in which material is presented to a learner which facilitates learning.
Teaching strategies are the ‘methods’ teachers adopt to encourage (or discourage) learning in the classroom. Providing a well planned lesson that utilizes effective teaching strategies is essential to successful teaching and learning.

According to Eggen(1979), “The educational goals have been divided into cognitive, affective and psychomotor domains. Cognitive goal addresses the development of the students’ intellect; affective goals are concerned with emotion and social growth: the psycho-motor goals aim at acquisition of manipulative and movement skills. Cognitive goals are important in information processing, the affective goals in the development of attitudes while the psycho-motor goals are necessary for the development of mental process. Thus all the three need to be taken into account while deciding strategies of teaching”. The sequence in which the material is presented to a learner is the teaching strategy that facilitates learning.

3.9. ACTIVITY BASED APPROACH

An activity is something which is carried out with a purpose in a social environment involving physical and mental action. Such activities help in the establishment of stimulating environment for creative expression.

Activities are meant to provide varied experiences to the pupil to facilitate the acquisition of knowledge, experience, skill and attitudes. Children enjoy wholesome living in stimulating environment where desirable attitudes, interests and skills are formed. The child builds self-confidence and develops understanding by working in a group.

Activities vary according to the age group to which the pupils belong. At the primary stage, activities like painting, drawing, designing, wood carving.
writing, composing, dancing, interviewing, acting, reading, map-making, graph-making, field trips, gardening, playing, etc. are useful. It is not always necessary that activity should only be physical; it can also be mental activity. Knowledge and understanding are imparted through mental activity. Thus the central principle of activity based approach is “Learning by doing”.

The principle of learning by doing applies to the child’s thinking. According to Froabel the important practical instruction to teachers is “come let us live with our children.” The mind of the young school children is dominated by precepts and images and impulsive responses thereto. The mind of the adult with his linguistic powers may be occupied with verbal symbols that have no relation to his immediate surroundings. Between the two, a great gulf is fixed and the methods of the teacher must conform to the laws that govern its passage. In other words methodology must consider the psychological outcome of activity, and select such activities as will first of all strengthen the child’s hold upon his environment and enable him to give it a provisional interpretation, then lead him to a view of the world beyond, and so put him in the way of seeing himself and his immediate surroundings in their relation to the general scheme of things.

According to Piaget’s theory of concept operational stage, the child acquires fine motor skills and organizes his thinking into system with inner rules. We must refrain as far as possible from doing the child’s thinking for him. Too much help prevents a child from actively using his mind. He will gradually get into the habit of expecting the teacher to do his thinking for him. He sits while the teacher talks, knowing that notes is going to be dictated later and that all he has to do is to take these notes down. Later he can ‘learn’ them. This is not real learning. The child can learn only when his mind is active. Such guidance as we give, must stimulate his thought and not kill it.
We know how true it is that if we do not use the power we have, we lose it. It is equally true of what we learn. If we do not use what we have theoretically learned, then we soon tend to forget it. This is due to the fact that the process of learning has not been completed. Doing is necessary if the knowledge we learn is really to become ours. Hence this principle of learning by doing is essential in all learning. It is not simply a device which we can make use of when we wish to have a change. But it is part and parcel of the learning process without which learning is not complete.

Activity or doing does not mean merely physical activity, though this usually comes first. But it means activity of the intelligence and also of the emotions and of the will. If a pupil is to develop all sides of his personality, it is necessary for him to be active in all ways, to exercise all the powers he has. This involves the psychology of perception, imagination, conception and judgement. The intellectual processes accompanying or developing out of activities that begin in instinctive impulses ultimately reach the level of clearly conceived purpose.

3.10. ACTIVITY FOR MOTIVATION

Anything which moves an individual to action may be described as motivation. Children are moved to action, in other words, motivated, when they are in a state of tension or disturbed equilibrium. When tension is removed and the equilibrium restored, a state of quiescence ensues. Tensions arise when an individual sees or imagines an object or a state which he does not possess but he desires. In other words, he 'feels' the need to know what he does not know. The teacher has to provide for and inculcate such motives as would channelise the pupil's activities in the desirable lines. The teacher has to manipulate the
atmosphere in such a way that the child feels that if he does not pay attention, he will be losing something valuable.

Generally teachers motivate the children through stories, songs, games, etc. An effective motivation makes the children alert, and makes them learn a particular topic in an effective manner. In the activity based teaching strategy, the teacher can design a physical or mental activity, which is closely related to the competency to be dealt with. Solving puzzles is a mental activity which can help the children to think, and his mind gets ready to learn. For example, before beginning to teach the unit 'weight', the teacher should present the following puzzle to the beginner. There are three balls of the same shape and size, among which two balls are of equal weight while the other's weight is different. The children are asked to identify the ball with the different weight by a single use of the common balance. Games and puzzles motivate the children by providing physical and mental activity.

3.11. BLOOM’S TAXONOMY OF EDUCATIONAL OBJECTIVES

Benjamin S. Bloom and his associates developed a framework for identifying and classifying a comprehensive range of educational objectives, and worked for twenty years and developed a taxonomy of educational objectives. Taxonomy is a complex scheme for classification of phenomena or ideas. Bloom’s taxonomy is an attempt to identify, define, classify and organize a comprehensive range of educational objectives into a compact and measurable structure.

After Bloom, experts like Robert Menges (1981) and A.J. Romiszowski (1984) have developed other schemes of classification of educational objectives.
But Bloom’s scheme is the most widely used one in academic programmes around the world.

Bloom’s taxonomy of educational objectives consists of three domains: the cognitive, the affective and the psychomotor. The objectives of each domain constitute a hierarchy consisting of major categories and subcategories within the major categories.

3.11.1. Cognitive Development

Many psychologists believe that cognitive development is largely a matter of acquiring domain specific knowledge which means knowledge of a specific content area that makes new related information more meaningful.

Cognitive development is the beginning of formal operational thinking and increasing the ability to engage in mental manipulations.

The Taxonomy for the cognitive domain was developed by Benjamin Bloom (1956) and several associates are composed of six levels i.e., knowledge, understanding, application, analysis, synthesis and evaluation. The objectives of teaching Primary level Mathematics is focused on the first three levels (i.e) Knowledge, understanding, and application. So a Mathematics teacher handling the Primary classes should have a thorough knowledge in the three levels of cognitive domain under each competency. This will help the teacher to develop his teaching strategy in an effective manner.

3.11.2. Knowledge Through Activity

According to Bloom’s Taxonomy of educational objectives, knowledge is the lowest category among the other categories in the cognitive domain. Knowledge is the ability to remember and recall or recognize already learned
information. It includes knowledge of common basic terminology, specific facts methods and procedures, fundamental concepts and principles. Knowledge of specifics, knowledge of ways and means of dealing with specifics and knowledge of universals and abstractions are the major categories in knowledge. Recall, recognize, state, define, list, narrate, recite, quote, etc are certain action verbs related to the area of knowledge.

While teaching Mathematics at the primary level, the teacher can help the child to recall his previous basic knowledge in Mathematics and coordinates it with the newly learnt material. Certain activities effectively help them to repeat the acquired matter in order to retain it in their minds. For example, when the teacher introduces the concept of unit area, he makes an illustration by marking and shading 1 sq. cm on a graph sheet.

Observation of this demonstration gives the children the knowledge of 1 square cm. When the teacher asks the children to do the activity of shading 1 square cm, they recall the already gathered information to their memory. This activity leads to long-term memory. Only short term memory can be expected in the absence of such activities.

3.11.3 Activity for Understanding

The next higher category is comprehension or understanding. It is the ability to organize and arrange materials mentally without necessarily relating it to other material. The major categories of understanding are translation, interpretation and extrapolation. Tasks involved in comprehension level are: understanding information, grasping the meaning, translating the knowledge into a new context, interpreting the facts, comparing, contrasting, ordering, grouping, inferring causes and predicting consequences. Describe, explain, illustrate, give
reason, identify, substitute, distinguish, compare, classify, contrast, detect error, establish relationship, interpret, derive, give example, translate, prove, infer, substitute, illustrate, etc are the action verbs related to the level of understanding.

Activity based teaching of primary level Mathematics helps the children to see the relationship between the different items of the material, translating abstract ideas into concrete structures or figures. After imparting the knowledge that “average” refers to “equal distribution”, the teacher should introduce physical activities followed by mental activities to arrive at the formula

\[
\text{Average} = \frac{\text{Sum of observations}}{\text{Number of observations}}.
\]

The children shall be divided into groups. The children of each group distribute unequally among themselves a certain number of beads (which are originally kept in multiples of the number of children in the group). Now the children are asked to gather the beads together and make them equal among themselves by distributing the beads one by one. In this way each group can see that equal distribution is nothing but clubbing and distribution. Clubbing is the “sum of the observations” and distribution is “dividing it by the number of observations”. This activity promotes the understanding of a formula through play way method.

3.11.4. Activity for Application

This higher category involves the ability to select and apply already learnt rules, procedure and principles to new and unfamiliar situations. It includes application of concepts and principles to new situations, application of laws and theories to practical situations like solving problems, thinking critically and in depth, constructing charts and demonstrating correct usage of a method or
procedure etc. Examine, judge the sufficiency of the given data, select appropriate formula, predict, formulate hypotheses, verify hypotheses, solve, apply, employ, and verify are the action verbs connected to this level.

A well planned activity based teaching strategy helps the children to use information methods, concepts and theories in new situations to solve problems. After the children had acquired the knowledge and understanding of the concept of “Average”, the children are divided in to two unequal groups. The two groups may be asked to collect the beads lying scattered on the floor within a stipulated time and are asked to identify the winning group. The identification of the winning group is easily done by finding the average number of beads collected by each group. This activity helps them to apply their knowledge and understanding of the concept already acquired.

3.12. ACTIVITY BASED EVALUATION

Older methods of evaluation have become outdated in modern education especially in the field of teaching mathematics. Evaluation is employed in a mechanical manner and so it is limited to solving a few problems or cramming the steps of the problems. Generally this kind of evaluation tends to create a negative attitude among the pupils, and naturally they are led towards disliking the subject. In the teaching learning process evaluation is a purposeful activity, and it should be based on the objectives. At the primary level, it is imperative that the achievement of the children should be tested through activity based evaluation. Meaningful evaluation is continuous and comprehensive and it helps the teacher to diagnose the weaknesses of the pupils. Through this kind of evaluation, the teachers not only come to know of the pupils’ progress but also find an opportunity to evaluate their own performance and learn the merits and demerits of the entire teaching-learning process. Activity based evaluation
conducted continuously not only helps the teacher to understand the specific problems of the pupils, but also provides purposeful interaction between the teacher and the student and enables them to come closer to each other.

3.13. STEPS IN ACTIVITY BASED TEACHING STRATEGIES

There are nine teaching strategies developed by the researcher with each item containing a set of steps to be followed in a systematic manner.

3.13.1. Activity towards Motivation / Warming up / Energizing

- Teacher initiates. Making the children listen to him.
- Inspiring the children to do the activity
- Making the children plan for the activity
- Enabling self-preparation of children to do self/group activity.
- Implementation / (Doing) of the planned activity
- Facilitating the active involvement of the children
- Making the children observe the completed activity
- Presenting a puzzle / question related to the competency
- Making the children think individually on the problem / puzzle
- Making them discuss in groups
- Interacting the solution with the teacher
- Confirming the solution / prolonging the puzzle

3.13.2. Activity towards Knowledge

(Know-how activities or activities leading to acquisition of knowledge)

- Listening to teacher’s speech
- Accepting
- Making the children plan for the activity
Enabling self-preparation of children to do individual / group activity
Implementing the planned activity
Facilitating active involvement of the children
Making the children to observe the completed activity
Knowing the outcome of the activity
Thinking the outcome of the activity by themselves
Sharing the outcome with others
Making them know the definition
Making them retain the definition in memory

3.13.3. Activities leading to understanding:
(Making the children understand or getting a general formula)
Making the children recall the definitions
Announcing the activities based on the definitions
Making the children know the activities
Allowing the children to come forward to do the activity
Making the children plan individual / group activity
Doing the activity
Teacher’s intervention if necessary
Facilitating the children towards active involvement
Encouraging the children to observe the completed activity
Making them apply the activity to large sample / different sample
Observing the outcome
Comparing the outcome
Identifying the relationship
• Making the children understand the outcome of different activities
• Deriving / Deducing a general rule
• Making the children think about the deduced rule
• Discussion of the rule with peers
• Realization of its application

3.13.4. Activity leading to Application

• To facilitate the children to understand the required result
• Making the children understand the concept
• Developing a mental picture / pictorial representation based on the concept
• Making the children recall rule / formulae
• Applying the rule/ formulae
• Getting the result through the rule / formulae
• Analyse the result with the given question
• Arriving at the answer for the given question through the obtained result
• Think individually about the answer
• Discuss with peers about the answer
• Interact with the teacher
• Confirming the solution

3.13.5. Activities leading to Recapitulation

• Arranging the competencies taught in a sequential order
• Inform the children one by one
• Making the children recall the learned competencies one by one
• Making the children recall the activities done to understand the concept
• Clarification of doubts

3.13.6. Exercises for practice

• The teacher facilitates the children to read the sum
• The teacher makes them understand the problem
• Making them arrange the data
• Helping the children recall the relevant formulae and rules
• Making the children apply the given data to the formulae

3.13.7. Activities towards Evaluation

• Recall the competencies
• Arrange the activities based on the competencies
• Present the activities to the children
• Making the children think
• Making the children do the activity
• Observe the activity done by the children

3.13.8. Remedial teaching

• Identify the children who are not able to do certain activities
• Identify the sums / activities which are not done correctly by most of the children
• find out the reasons
• find out proper solutions
• Implement the solution
• Confirm the attainment of the expected competencies among the children
3.13.9. Follow up activities:

- Relate the competencies with real life situations
- Identify a follow up work
- Confirm whether it can be done by the children or not
- Ask the children to do the follow up work

3.14. ILLUSTRATIVE EXAMPLE

**Unit:** Area of a Rectangle

**Objectives:**

1. To impart the knowledge of 1 sq. unit
2. To make the children understand the need for square units in the measurement of area
3. To help the children understand the method to find the area of a given rectangle in square units
4. To arrive inductively at the formula of calculating the area of a rectangle
5. To Calculate the area of a rectangle using the formula
6. To apply the formula in different situations

**Activities towards motivation**

The children are given 12 match sticks to be arranged into squares as shown below:
The children are allowed to find out the number of squares formed. After an initial look, the children give ‘4’ as answer but then they realize that the correct answer for the puzzle is ‘5’.

The arrangement of match sticks into squares within squares provides an interesting physical activity and the counting of the number of squares serves as an activity to develop the mental ability of the children.

This motivational activity is related to the topic to be dealt with. One big square is divided equally into four small squares. The area of a rectangle is also the number of unit squares contained in it. This automatically instills the basic idea or the concept and helps them to calculate the area of a given square or a rectangle.

Activity towards Knowledge

A shaded graph is shown to the children and the children are asked to draw and shade out the figures as shown in the graph sheet. It is explained to the children that the shaded part i.e. the square with a side of 1 cm denotes an area of 1 sq. cm.

It may be also illustrated through the graph sheet that an area of 1 sq. cm need not be always a square. It may be in different shapes as shown in the graph sheet.

Thus the children acquire the knowledge that the area of a square with 1 metre as its side is one square metre. In general, if the length of the side of a square is 1 unit, the area of the square is 1 square unit. Moreover the children
come to know that, just as centimeters and metres are measurements of length and gms. and k.gms. are measurements of weight, square units are used for the measurement of areas.

**Activities leading to understanding**

Rectangles of various dimensions are drawn in a graph sheet. Their length, breadth and area are noted based on the number of squares of 1 cm side for each rectangle. The children are facilitated to think about the relation between length, breadth and area. The teacher may help the children to identify the relation inductively that area is the product of length and breadth. The children feel confident and sure about the general rule.

\[
\text{Area of a rectangle} = \text{Length} \times \text{Breadth.}
\]

As a further step, exercises based on the deduced formula may be provided to the children.
Example:
Find out the area of a rectangle having a length of 14 m. and a breadth of 10 m.

Length = 14 m.
Breadth = 10 m.
Area of the rectangle = Length x breadth
= 14 x 10
= 140 sq. m.

Activity leading to Application

Judging or comparing the size of two rectangles whether they are bigger or smaller on the basis of area calculated with the given measurements may be done in two steps as in the following example:

The length and breadth of two rectangular fields A and B are 60 m., 45 m.; and 65 m. 40 m respectively. If both the fields have the same monetary value, which is profitable to the buyer?

To solve this problem the children may be asked to draw a sketch of the first field, mark its measurements and then calculate its area.

```
45m
60m
```

Length = 60 m.
Breadth = 45 m
Area of field A = 60 x 45
= 2700 sq. m
Then the children are asked to draw a sketch of the field B and its area is calculated.

Length = 65 m  
Breadth = 40 m  
Area = length x breadth  
= 65 x 40 = 2600 sq.m.

By comparison, the children can judge properly and get the correct answer.

Recapitulation activity

• Making the children recall the concept of area, by giving examples from daily life activities like painting, white washing, etc.
• Making them recall the definition of a square centimetre, a square metre, etc.
• Making them recall the relation between measurement of length and the measurement of area (to relate that, just as length is measured in cms / metres etc, area is measured in terms of sq. cms / sq. m etc).
• Making the children recapitulate the inductive method of getting the formula that the area of a rectangle is the product of its length and breadth.
• Making the children recall the method of applying the formula for calculating the area of a rectangle.
• Making the children recall the use of calculating the area of a rectangle in daily life.
Exercises for Practice

The children are given ample opportunity to draw rectangles in a graph sheet for given dimensions and to find their area by counting the unit squares inside.

Using the given dimensions, the children now draw rectangles for which they calculate the areas by means of the formula \( A = l \times b \).

The children are given practice to compare the areas of different rectangles.

Activities for Evaluation

1. Shading an area in a graph sheet in three different ways

2. Drawing a rectangle with the given measurements of length and breadth and counting the number of unit squares inside it to find out its area.

3. Finding out the area of a room or a hall of using the given length and breadth.

4. Calculating the area of two rooms or halls using the given measurements of length and breadth in order to find out the larger or the smaller room by comparison of the areas.

Remedial teaching

It is the duty of the teacher to identify the areas of difficulty and the mistakes committed by the children. Necessary illustrations and explanations should be given by the teacher to make the point clear. If the same mistake is
committed by many children, it becomes necessary to identify the reason behind the problem and particular portions to be re-taught with examples so that the entire unit is understood by the children thoroughly. If a particular type of mistake is committed only by a few children, that part of the unit may be taught through peer group teaching.

**Follow up activities**

1. The children may be asked to draw rectangles having the same area but with different dimensions.

2. The children are asked to draw rectangles having different area with different dimensions. They may be shaded in different colours.

3. They have to calculate the area using the formula, and verify the result by counting the number of unit square in each figure.

4. Colouring or shading and verifying the area strengthens the understanding of the concept and helps retention in memory.

**3.15.1. ENHANCEMENT OF PERFORMANCE**

Activity based teaching strategy developed by the investigator for the primary level children (children belonging to the age group 5 to 10 years) will make them mentally alert and physically active. The motivational step developed by the investigator will create an insight among the children. Moreover the attainment of objectives related to knowledge level, understanding level, and application level becomes possible among the children through a set of well planned activities.
3.15.2. DEVELOPMENT OF FAVOURABLE ATTITUDE

The term attitude towards mathematics is composed of two words 'attitude' and 'Mathematics'. Attitude is the opinion or position taken with respect to a psychological object in the field of Mathematics. The steps involved in the strategy give a clear understanding of the mathematical concepts which brings about a change in the feelings of the children concerning mathematics like faith in the mathematical method, opinion about the subject, values of mathematics, interaction of mathematics with individual and society, opinion held about mathematics related to daily life situations. It creates a tendency to react favourably towards mathematics.

Throughout the process of interaction, there is an interpersonal communication and involvement on the part of the teacher towards the children. The strategy provides an opportunity to identify the difficulties of the individual and to solve the problem of the children in the concerned area. This creates a positive attitude towards the mathematics teacher.

3.16. CONCLUSION

The steps followed in the strategy provide an ample opportunity for recapitulation. The exercises for practice help retention and long term memory. Continuous and comprehensive evaluation conducted through activities will enable the teacher to identify the mistakes committed by the children which paves the way for remedial teaching. Follow up activities will strengthen the learning outcomes and help the children to apply their knowledge and understanding of the subject in various life situations.