CHAPTER I

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1.1.0 Context of the Study

The last one hundred years has been a period of rapid change in education. John Dewey, Pestology and James were pioneers, who were responsible for changes in education. But the major changes in educational thinking and architectural responses came about after world war II, when the demand for new facilities occured, at the same time those social, cultural and technological changes, literally pushed education into new era. Changes occured so fast that the future can no longer be regarded as a reasonable extension of the past. A brief sketch of some of the present trends in education, as they appear, can do no more than to indicate the range and variety of changes and developments and to illustrate the point that current educational change is complex and wide-spread and has many forms. In a situation in which education is seeking to further a wider variety of objectives in a multiplicity of ways and in which education is open to a wider range of social influence and in which change is proceeding at a greatly increased speed, our country has faced more complex and fluid conditions, than those which existed only twenty or thirty years ago.

One of the basic philosophical considerations, is the continuous change that occurs in education from time to time,

as a result of research. Such changes, based on new knowledge, should be introduced for the sake of accuracy without sacrificing the learning potential of students. The students who are under adequate guidance and experience may be encouraged to develop into future creative scientists. In future, our nation cannot depend on sheer quantity of man-power, but must strive to find high quality personnel, especially creative persons to deal with its vital problems.

Since 1947, those willing to recognize the true situation were knowing that our nation is facing manpower problems. Even from a long period of time, it could be seen that we lacked sheer quantity of available manpower in comparison with our potential international competition. If we are to survive in international competition, our most promising solution to this vital manpower problem for this nation is to encourage and support the identification and development of various types of important personnel. One such type is the highly creative persons for even few such persons in science can keep our scientific movement vigorously infront. Creative acts affect enormously, not only scientific progress, but society in general, these nations who learn the best, how to identify, develop and encourage the creative potential in their people may find themselves in very advantageous position. Creativity at its highest level has

probably been as important as any human quality in changing history and reshaping the world. Societies cannot be easily and radically changed by the human will according to plan ; rather, it is the creativity with which the members of a society are endowed that accounts for internal dynamics of a society.

To-day, when widespread, deep and rapid changes are taking place in the very structure of our lives, whether we desire it or not, and when still other changes seem necessary to preserve us from disaster, understanding of the creative process is particularly important. Because it can be in the control of these difficult developments. The creative process is the process of change, of development, of education, in the organization of subjective life. The exploration and enhancement of creative abilities is a matter of contemporary social significance has given the current rate of social, cultural and technological change. In fact, the very future of nation to-day depends on how well it has trained its young ones to think creatively. The programme of experimentation for educational improvement has to be planned in the context of the quantitative expansion of education, throughout the country. The emphasis has to be put on qualitative improvement which obviously has not received adequate attention of the administrators in this field. So one of the acute problems of education in our country is to emphasize qualitative improvement.

Creativity is considered as an index of the quality of education. Creativity has been a topic of some interest throughout man's history, too little is currently known about its nature. Not nearly enough empirical research has yet been accomplished. Only a trickle of research articles on creativity appeared in the scientific literature. However, increasing interest and activity have opened many avenues of research in this area.

1.2.0 Background of the Problem

A spring of fresh water is a nuisance when it first issues from the ground, producing only mud and mire. It cannot be stopped by cement or earth till its flow continues to seep around the edges. But when the spring is given a protective and delimiting margin, and a channel is provided for its stream, it becomes a source of joy. The same is true of creativity. An attempt to help educators to transform the muddy beginnings of creativity already lying in the children which they teach and counsel, into a flowing stream is necessary. The spring of creativity exists in all children, but in most of them, the flow has been blocked. Like the spring, creativity is at times destructive, and the young child reacts and destroys almost in the same breath. The social problem is to obtain the benefits of creativity without its destructive results. The work is needed to help increase,

the total effort put in for learning more about creative talent and developing it in science and other fields. The research is required to develop the guiding principles for science teachers to help them modify or adopt new science programmes to fit into the needs of the community. It seems that the type of education needed to bring about the required talent, must be developed in terms of creative ability. It is necessary to develop procedures, scientific situations, personalities and the type of learning climate or environment that encourages the youth in primary schools to use scientific knowledge creatively. The development of creative thinking skills seems to be important to every individual. Torrance (1965) believes that creative thinking is important in all areas of life and that the prolonged enforced repression of creative desire may lead to the actual breakdown of the personality. Creative thinking contributes to the acquisition of information,and is essential in the application of knowledge to personal and professional problems.

Now that we have built up a considerable body of knowledge about human behaviour, of which creativity is unique and invaluable aspect, education no longer can restrict itself to rote learning. It is truism to say that at no other time in man's history the need for developing the creative thinking

of children has been so great as it is now. To guide and to promote creative talent among our pupil$^{\underline{s}}$ is an accepted goal of education to-day. Hence new approaches to understanding and conducting of the teaching process is necessary. This means that we should make an attempt to identify, define, measure and promote. creative thinking of the pupil with zeal and enthusiasm. We often say that traditional methods of teaching, will not be able to stimulate creative thinking amongst pupils, hence one can expect to find out proper teaching strategies for the purpose. Very little has been done by the way of experimentation with creative training procedure, particularly at primary level in the subjects of science, and nearly nothing substantial has been reported about the effects of providing such nurturing to the primary school children.

It is the purpose of this study to investigate the effects of teaching primary school children to think in creative ways. The need of promotion of creative thinking in science teaching in particular is a stark and self-evident truth for every developing country, if it wishes to contribute to the world culture and thereby to have its esteemed place in the comity of nations. Consequently, researcher believes that contribution on problems of creative science teaching will definitely be useful.

1.3.0 What is Creative Thinking ?

Inspite of the enormous amount of research on creativity during recent years, there is no clear and concise definition of creativity accepted by all. As in many areas of the growing discipline of assessment and prediction, the criterion problem remains an unanswered challenge. Though, at present, the field of creativity has been widely explored by many researchers, the efforts to understand it, started around in the first quarter of this century. Terman, Flannagan etc. continued working in this area af that time. Educationists and psychologists took keen interest in the intriguing field of creative thinking around 1950. Taylor, Thurstone, Guilford and their associates were the pioneers in this field of knowledge. Following the contribution of some of the important studies of Flannagon, Steltz, Chochran, Torrance etc., a series of national conferences held at the University of Utah, during the later part of nineteen fifties, helped for the growth of knowledge in this field of creative thinking. At present a number of researchers and research institutions are involved in finding the different aspects of creative talents in man.

Creative thinking was not considered as a separate mental talent till very recently. The intelligence was the

only ability that was measured and was considered supreme in judging all human tasks. Getzels and Jackson (1962) from their study revealed that high intelligence does not guarantee high creativity. After the study of Getzels and Jackson, many studies were conducted which convey that though creativity is slightly related to intelligence it really contributes a separate cognitive factor which owes little to conventional intelligence.

Before actually discussing what creative thinking is, it is fit to state, again, that like many other concepts in psychology there is no single definition of creativity which is universally accepted. There are number of definitions and explanations about creativity; and they differ from one another, slightly or to a great extent, put forward by the prominent researchers. Vinacks (1952), Ghiselin (1963) and Zimmerman (1964) realized the difficulty in arriving at a universally accepted definition of creativity and felt that different meanings to term creativity could be assigned by different workers in the field. Having seen the various definitions of creativity, Mackinnon (1970) comments that many are the meanings of creativity. Perhaps for most, it denotes the ability to produce something new into existence, while for others, it is not an ability, but the psychological processes by which novel and valuable products are fashioned.

This mental ability of creative thinking is sometimes called by different names by different researchers. De Bono (1970) talks about lateral thinking. According to him, lateral thinking is an indefinite way of using the mind as logical thinking, but in a very different way. He says that lateral thinking is an insight tool. It is concerned with the generation of new ideas. It is different from vertical thinking, which is concerned with providing or developing concept pattern. Lateral thinking is concerned with restructuring such patterns and provoking new ideas. According to Guilford (1956) in his model of 'Structure of Intellect' the creativity involved the interplay of all factors of divergent thinking on the one hand and the factors of seeing problems and evaluation on the other. Guilford productive thinking is of two types, viz. convergent production and divergent production. Convergent is like De Bonos' vertical thinking. It leads to one right answer or to a recognised best or conventional answer. But divergent production leads to many ways of finding the answer.

De Haan and Havighurst (1961) on the basis of Guilford factorial studies, observed that creativity included seven factors, namely (i) Sensitivity to problems (ii) Associative fluency (iii) Ideational fluency (iv) Spontaneous flexibility

(vi) Originality and (vii) Redefinition.

Rhodes (1961) writes that creativity may be considered from the standpoint of the (i) 'person', who creates, that is in term of physiology and temperament, including personal attitudes, habits and values (ii) 'processes', mental processes, such as motivation, perception, learning, thinking and communication (iii) 'press', i.e. environmental and cultural influences, or external influences, which can enhance or hinder the development of creative thinking, and finally (iv) 'products', such as theories, inventions, paintings, carvings and poems. He has defined creativity as 'a noun naming the phenomenon, in which a person communicates a new concept which is the product'. He felt that the mental process was implicit in the definition and it would be impossible to think of a person living or operating in a vacuum, so the term 'press' is also implicit in it.

Good and Markel (1959) described creativity as a quality thought to be composed of a broad continuum upon which all members of population may be placed in different degrees.

Hebb (1949) expressed creative thinking as a function of relative strength of conscious and unconscious processes.

Simpson (1922) defined creative ability as the imaginative that one manifests by the power to break away from the usual sequence of thought.

Lowenfeld (1959) distinguished between actual creativity and potential creativity, the former being that potential which is already developed and functioning, the later including the total creative potential (both developed and underdeveloped) within an individual.

The working definition of creativity used by Stein (1953) is that a process is creative when it results in a novel work that is accepted as a tenable or useful or satisfying by a group at some point in time. From this definition it is clear that creativity should end in a novel, useful satisfying product.

Rogers (1959) says that creativity is self realisation and the motive for it, is the urge to fulfil oneself.

Rollo May (1959) defines the creative act as 'encounter characterized by a high degree of awareness'.

Hans Sely's (1960) believes that creative discoveries processes, to a high degree and simultaneously the following three qualities. 'They are true, not merely as facts but also in the way they are interpreted, they are generalizable and

they are surprising in the light of what was known at the time of discovery'.

Piers and others (1960) defined creativity as the capacity of an individual to avoid the usual routine, conventional way of thinking and doing things and to produce a quality of ideas and of products which are original, novel or uncommon and which are workable. It must be purposeful and goal directed. It may involve the forming of new patterns and combination of information derived from past experience and translating of old relationship.

Barron (1964) opined that creativity is energy being put to work in a constructive fashion.

Haefele and Mednick (1962) says that creativity is the ability to make new combinations; the creative process is the means of making them the new combination is an innovation and high creativity is the ability to make innovations of social worth.

Parker (1963), describes creativity as 'the art of seeking out, trying out and combining knowledge in new ways'.

Kneller (1965), says that 'creative thought is innovative, exploratory, venturesome, impatient of convention, attracted to the unknown and undetermined'.

Torrance (1964) defined creativity as 'a process of becoming sensitive to problems, deficiencies, gaps, in knowledge, missing elements, disharmonies, and so on, making guesses or formulating hypotheses about deficiencies testing and retesting these hypotheses and possibly modifying and retesting them, and finally communicating the results.'

Passi (1971) says, 'creativity is a multi-dimensional (verbal and non-verbal) attribute differentially distributed among people and includes chiefly the factors of solving problem, fluency, flexibility, originality, inquisitiveness and persistency.'

From above discussion, it is clear that definitions of creativity range all the way from the notion that creativity is simple problem solving to conceiving it as the full realisation and expression of all of an individual's unique potent abilities. One would be ill-advised to seek to choose from among these several meanings, the best single definition of creativity, since creativity properly carries all of these meanings and many more besides. It may be pointed out at this stage that creative thinking is accepted to be marked by the action of mind purposefully directed to manipulate the environment with a view to create new ideas and establishing novel patterns and relationship. The recent trend is also to

to accept creative thinking as a multidimensional ability which is complex, universal human attribute, manifested by the cognitive empirical process and is differentially distributed among different people.

1.4.0 Teaching Strategies

Teaching behaviours, when occur in logical order, help in pupils' learning. If one has to find out the outcome of certain teaching behaviours, these have to be repeatedly practised in the classroom processes. Various terms like strategies, patterns, models are used by researchers, when certain behaviours are stressed in the classroom. Strategy is a key term used in this study and a detailed understanding of it is very necessary for scientific communication of ideas. The ongoing discussion indicates what a teaching strategy means.

Smith et al (1967) considers that a strategy is a way of looking at the activities involved in classroom discourse. It refers to a set of verbal actions that serve to attain certain results and to guard against others. There are two dimensions of a strategy, namely, the treatment and the control dimensions. The treatment dimension concerns with the type and sequence of operations that the teacher and the pupils jointly enter into in setting forth and structuring

information in such a way as to disclose the content that is to be learned. The control dimension deals with the operations, the teacher uses to guide and control the participation of pupils in performing these operations on the content. There seems to be a slight shift (though appears to be same when further explanations are checked)by Smith and Meux (1970) in stating what a strategy is. They refer to strategy as a pattern of acts that serve to attain outcomes and to guard against certain others. The term 'pattern of acts' used by Smith and Meux (1970) need not refer to only a 'set of verbal actions' as given by Smith et al (1967).

Hough and Duncan (1970) define a strategy 'as a pattern of substantive, managerial, or silent behaviour used to facilitate student attainment of an objective'. Further it is composed of a series of moves, where a move is defined as a single event that starts with the initiation of a behaviour and ends with its transition to another behaviour. But the strategies do not involve all types of teaching behaviours. They are often used in conjunction with tactics. A tactic is defined as a pattern of appraisal behaviours used to support the primary instructional pattern i.e. the strategy. To give an example, teacher asking a question, followed by a move to student response, and a student response followed by a move

to another teacher question, forms a strategy. This strategy
is supported by appraisal of behaviours such as confirmation
and corrective feedback.

Though Gerhard (1971) uses the words 'teaching yet
there is no definition of the term provided. He says
'traditionally, teaching strategies have been classified as a
series of methods, ranging from the lecture, discussion and
racitation to multi-method, the project, the self-discovery
and the self-selection approach, provided with these methods,
how do we use them to promote process and how do they fit
within the behavioural approach ?'

Fraenkel (1973) considers teaching strategies exclusive
of pupils' learning activities. Teaching strategies refer to
operations, a teacher performs in order to involve students
in activities to help them learn, whereas learning activities
represent things which students do, or actions in which they
engage. This idea of a teaching strategy involves only the
teacher behaviours and not the pupil behaviours).

The term strategy has also been used by Flanders (1970),
though not clearly defined, it seems that a strategy is the
way in which the teacher handles a classroom situation in
order to facilitate learning.

To isolate and study a single teacher behaviour or a student behaviour is difficult as they are parts of a complex system. Hence it is more plausible to have some selected teaching behaviours, which develop a teaching strategy and study the effect of these teaching strategies on the pupils outcome in terms of attainment and creative thinking.

1.5.0 Can Creative Thinking be Developed ?

More and more research projects have been pointing up the part that education can play, in the development of creative efficiency. A good number of studies agree with the statement that environment is the major factor that enhances or curtails the development of creative thinking. Torrance argues that, 'perhaps the most promising area if we are interested in what can be done to encourage creative talent to unfold, is that of experimentation with teaching procedures which will stimulate students to think independently, to test their ideas,and communicates them others'. He himself conducted a number of studies about classroom climate for development of creative thinking and he found that engaging in a larger variety of creative activities may result in greater word fluency. He also found that differential rewards, influences originality of thinking.

Spaulding (1963) found that students' feelings and
performances were related to the affective and emotional
atmosphere developed by the teachers. He observes that
the teachers were the important figure in the development
of both cognitive processes and personality characteristics
in children.

Mcnary (1967) found that teacher personality traits
were most effective of change producing variable and that
different types of teachers influenced different areas of
growth. The development of creative abilities in the
students were found depending upon the attitudes of their
teachers also. Ray (1974) findings led to the conclusion that
teacher whose educational attitudes were progressive,
considered important for encouragement of productive creative
personality. Studies have demonstrated that more the dominancy
of teacher - more the creative thinking of pupils.

Parnes (1962), the Director of the Creative Education
Foundation, Buffalo also noticed that creative problem
solving course was found to be helpful to students of low
and high initial creative ability.

Amaram and Giese (1965) studies indicated that the
students in the classrooms by training can gain in originality,
Problem solving skills of children could be nurtured. Also in

a study of the University of Minnesotta, Amaram (1968) reported that creative training gave the under achievers, the motivation and skill to solve his own problems. From his study it was favoured that creative training should be included in the school curriculum.

Certain efforts have been made in India for development of creative thinking among the children. In 1971 a creative teaching unit was established in Aligarh. Muslim University which was sponsored by National Council for Science Education, with a purpose to nurture creative thinking of students and develop specific courses for it.

Lindgrem (1969) and Belchar (1973) studied the effect of film-mediated models on the children's verbal creativity and reported a significant positive effects of films on verbal creative thinking.

The above discussion reveals that many studies have been conducted in which different methods and programmes were tried in order to find out their effects upon various levels of creative thinking, and indicates that there are research evidences for the hunch that creative thinking can be fostered.

1.6.0 Different Approaches of Fostering Creative Thinking

Since creative thinking is an infinite phenomenon and person can be creative in an endless number of ways (Torrance, 1971) there can be, perhaps, endless ways to devise models for identification and potentiating this important mental functioning. It is well-known that different methods of development of creative thinking are practised to a large extent in the fields of business, advertisements, military, etc. for finding out solutions to the problems. In the following paragraphs an attempt will be made to give a brief discussion on different approaches for developing creative thinking of children.

The earliest landmarks in this field are the creative problem solving courses instituted by Crawford in 1931. At present it is known as Attribute listing. Crawford (1954) explains 'Each time we take a step, we do it by changing an attribute or a quality of something or else by applying the same quality or attribute to some other things. It is not only a method of developing creativity but an explanatory theory or creative process.'

In the last century many people believed that any problem could be solved by opening the Bible at random and selecting a verse. This would indicate the solution. The little red book of

quotations from Chairman Mao is similarly invoked in China to-day.

The power of introducing an unexpected element into problem situation can be seen in several different environments. A fresh stimulus jerks the mind out of its set of assumptions. This method is known as 'Nonlogical Stimuli' which enables to approach creative thinking.

Brainstorming is another popular method of creativity developments. Osborn (1951) is the creator of this technique. Reasons for the very wide acceptance of brain-storming are quite clear. It is simple, fan and appealing. It stimulates interests, the power of association, a spint of competition, free use of imagination and active participation. It is relatively economical in terms of time, does not necessitate any elaborate class-room arrangement and can be effectively used with both small and large groups. It eliminates time waiting arguments during discussion and encourages participation by all students without the possibility of destruction or cynical criticism by others.

'Synectics' is another approach, put forward by Gordon (1961). This method represents a problem solving strategy, approaching brainstorming in its impacts. Synectics emphasises the principle of making familiar things unfamiliar and unfamiliar

things familiar. It is a state of mind disciplined for deliberate flexibility and imagination. Gordon talks about four mechanisms of making stranges each metamorphical in character. They are (i) personal analogy (ii) direct analogy (iii) symbolic analogy and (iv) fantasy analogy. According to him without these mechanisms, no problem stating and problem solving attempt will be successful.

Boundary test is also applied in approaching creative thinking. When one defines a problem, one makes a statement about its boundaries as one sees them. Provided one accepts that these are open to modifications the definition is only a sorting point to problem solving.

Haefele (1962) developed a technique called the Collective Note Book. A note-book is given to all competent individuals. Every one records in his note-book, one to several times a day, his thoughts and ideas on the problem for a period of a month. In the last, he summarises his best ideas, suggestions for fruitful directions, other new ideas etc. At a specific time all handover their note-books to the co-ordinator. He carefully summarises the ideas.

Another method for development of creative thinking is morphological analysis. It is fairly similar to attribute

testing. Zwicky (1963) the propagators of this method says that since the morphological analysis leads to all vistas and perspectives and also strives for perfect achievements, it is logically, artistically and ethically, extra ordinary satisfying . This method believes that every individual is potential genius and therefore it is suitable for all types of people in the intellectual hierarchy. This approach enables to systematise the inventiveness. It allows the problem solving methodically and in some cases automatically. 'Black Box' technique is extensively used in human relations and engineering programme for developing creativity. The use of this technique is similar to the personal analogy of the synectics method. Little (1967) developed technique which is known as 'The Little Technique'. It is like group Brainstorming. The difference under this method is the group leader knows the exact nature of the problem under consideration, but not the members.

Davis et al (1969) have developed a checklist to stimulate ideas. In the 'checklist procedure, students or members of the group have to consult the prepared list for the problem. Each item of the prepared list will be considered as a possible source of innovation with respect to the given problem. It is nothing but an organised and systematic consideration of each item on a prepared list as a possible innovative source relative

to the problem at hand. The well known checklist always start with several questions, which spur ideas.

'Organised Random Search' is a method introduced by Williams (1960). It can be called an innovation of Brain Storming technique. This method imposes an organisational method of problem analysis during the stage of ideation in the place of random jumping around for ideas. The divergent thinking is still possible in finding out solutions, within a directional pattern rather than hit or miss attack.

Doland Phillips (1967) developed a method known as 'Phillips 66' or 'Buzz Session'. In this session the audience is divided into a number of small groups of about five to eight persons. Each group selects its own chairman and retires to convenient place for discussion. At the appointed time they meet again, when the chairman of each group summarises its findings for the benefit of the audience.

As stated earlier the above mentioned methods have been mainly used in fields other than education. In very recent years many attempts have been made to introduce some of these techniques into education. Getting momentum from the results of various studies, different researchers in this field started working with one of the above mentioned techniques for the

development of creative thinking. But Torrance (1971) observed
that 'in our creativity research and development work, all of
us have been guided consciously or unconsciously by some
model' is quite proper. Unfortunately a few researchers,
however, have taken the trouble to analyse and evaluate existing
methods of teaching, and make deliberate choice of above
discussed methods. Considering this situation, the investigator
thought it fit to use the conventional methods for present
study.

1.7.0 The Present Study
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The title of the study reads as 'An Experimental
Investigation of the Effects of Selected Teaching Strategies
on the Development of Creative Thinking and Achievement in
Science'. It is an experimental study consisting of experiment
to find out the effects of four teaching strategies on the
development of creative thinking among the seventh grade
pupils and their achievement in Science, thus it aims to
find out a strategy which is more effective in realising the
pupils expected outcome. Ultimately the present attempt
ventures to study the possibilities of teaching for developing
creative thinking among school students. The teaching content
selected for the study comprises four units in science. The
independent (i.e. treatment) variables are the four teaching

strategies, namely Strategy I (i.e. Lecturing), Strategy II
(i.e. Lecturing with Discussion), Strategy III (i.e. Lecturing
with Discussion and Practical Work) and Strategy IV (i.e.
Lecturing with Discussion, Practical Work and use of A.V. Aids).
The dependent (i.e. criterion) variables are creative thinking
and school achievement in science. The ongoing discussion
provides the details about the terms used in the problem.

1.7.4.0 Four Teaching Strategies :

The term 'teaching strategy' has been explained in
caption 1.4.0. The four teaching strategies designed for
this study are (i) Strategy I i.e. Lecturing,(ii) Strategy II,
i.e. Lecturing with Discussion, (iii) Strategy III, i.e.
Lecturing with Discussion and Practical Work and (iv) Strategy
IV, i.e. Lecturing with Discussion, Practical Work and use of
A.V. Aids.

It is clear that selected strategies are graded and step
by step increase the students involvement. The following
discussions provide details about the variables involved in
the different designed strategies and also rationale behind it.

1.7.1.1 Strategy I i.e. Lecturing :

The present study
involves the teaching of science. Science is a branch of
human knowledge which constantly progresses with a persistent
inquiry. Though science teachers know that lecturing is not
more effective than other methods, they use mostly lecturing

in the classroom, with little experimentation and questioning. In a study by Bondesson and Larsson (1970), it was found that the direction method, where principles were presented and exemplified, was superior in efficiency and transfer value to the discovery method, where principles were discovered from examples. This makes one feel that lecture method is also superior for certain aspects of education. This arguments should be put to experimental testing or should be examined in relation to empirical related studies.

On the basis of the review of studies and thinking as above, it is stated here that, lecturing forms one of the teaching techniques involved in the formation of the four different teaching strategies of this study. Lecturing, here means teacher presenting subject matter verbally with the little help of demonstration, but there will be no direct involvement of pupils during teaching session, i.e. the pupil participation will be reduced to a considerable extent.

1.7.1.2 Strategy II i.e. Lecturing with Discussion :
Asking questions is the minimum of the students' participation in the classroom activities, compared to other direct ways of students' participation. Generally the teacher involves questions in the classroom and that way he takes initial for exploring discussion in daily teaching. So the second important

variable involved in this study is discussion. Teachers asking questions and pupils responding leads to pupil participation, in the teaching-learning process. By this way discussion occurs. It develops a democratic climate in the classroom.

Considering Flanders view, the teacher will be some what indirect in this strategy. Many studies involving this technique have been conducted, keeping in view, the different objectives. Amidon and Flander (1961) found that the pupil achievement in geometry increased, if the teacher were indirect. Study of Lulla (1973) also supports these findings. So achievement and creative thinking may be expected to be higher in this strategy.

1.7.1.3 Strategy III - Lecturing with Discussion and Practical Work : 'Experimentation is the soul of science teaching' and hence in the syllabus every standard there are incorporated some experiments which students are required to perform compulsorily. Due to this the third important variable of practical work was incorporated in the present investigation. Thus it will be clear that the third strategy evolved is the happy combination of lecture, discussion and practical work.

Normally the teachers allow pupils to perform such experiments which are already mentioned in the syllabus. Due

to the paucity of monetary funds and insufficient physical facilities we are not in a position to create the ideal situation of providing the facility for individualised practical work. Very few schools have facilities to reduce this ideal to concrete. So the teacher finds out a happy compromise by giving the practical workto small group of pupils at a time and thus, satisfies himself that he has tried to fulfill the objective of developing practical skill partially. In the present investigation the above situation has been kept fully in view while implementing the Strategy III. Thus, it must be evident by noww that strategy III means lecturing and discussion corroborated by a handful of practical work to be done by pupils.

1.7.1.4 Strategy IV - Lecturing with Discussion, Practical Work and A.V. Aids : When the technology is running through the nerves and veins of the society, how long can education afford to pay no head to it ? Today, modern instruments like computers, learning machines, 16 mm projector, T.V. and videotape etc. have become the part and parcel of classroom teaching in foreign countries and it will not be so long when they will cross the threshold of our classrooms too. Most of the Indian universities have incorporated the subject of Educational Technology in the B.Ed. course. The technology knocks at the door. Many schools have filmstrip projector,

taperecorder, T.V., 16 mm. projector, overhead projector etc. and the science teachers have been found using these aids off and on. It is our misfortune that our teachers do not appreciate the advent and advantages of the technology in education and do not accord a warm hearted welcome to the , changing times. It is thought that the effects of A.V. aids on the development of the creative thinking should be studied and hence A.V. aids have been taken as the fourth variable. That the A.V. aids add the novelty to the teaching process and make it lively and interesting, is indoubtable. With the help of A.V. aids we can provide indirect experiences to pupils. For present study strategy IV means lecture, practical work, discussion and the addition of the use of a variety of A.V.aids which would be useful in elucidating the content.

In the present study the four variables namely Lecture, Discussion, Practical Work, and A.V. aids are used in combinations to form the four teaching strategies. Though already stated in caption 1.7.1 repeat once again the strategies are Strategy I, that is Lecturing, (ii) Strategy II - Lecturing with Discussion, (iii) Strategy III - Lecturing with Discussion and Practical Work and (iv) Strategy IV - Lecturing with Discussion, Practical Work and A.V. Aids. They can be schematically represented as follows :

Table : I : Schematic Representation of the Four
Teaching Strategies

Strategy	Variables			
	Lecturing	Discussion	Practical Work	A.V.Aids
I	✓			
II	✓	✓		
III	✓	✓	✓	
IV	✓	✓	✓	✓

Looking to the above discussions regarding the variables
that is Lecturing, Discussion, Practical Work and A.V. aids,
which in different combinations form the four teaching
strategies. It can be visualized that the strategies, in
increasing order of their effectiveness for developing
creative thinking among pupils are Strategy I that is
Lecturing, Strategy II - Lecturing with Discussion, Strategy
III - Lecturing with Discussion and Practical Work and
Strategy IV - Lecturing with Discussion, Practical Work and
A.V. aids.

1.7.2.0 Creative Thinking :

Investigations have shown that there are two distinct
modes of thinking, one is referred to as convergent thinking
(i.e. intelligence) and the other is called divergent thinking

(i.e. creativity). The former mode of thinking is the one that is normally engaged in; it refers to the conventional, stereotyped, habitual way of thinking. The divergent thinking on the contrary, is the antithesis of the routine, stereo-typed or imitative pattern of thinking or performing. Divergent thinking involves 'fluency', 'flexibility' and 'originality' among others. In short convergent thinking involves logical necessities and divergent thinking involves logical possibilities.

When we develop, organize and recognize ideas, objects or words, and arrive at a product which is novel, original, unexpected and imaginative in its new form, we are thinking creatively. Creative thinking is new thinking. The term creative thinking has been explained fully in caption 1.3.0. In this study investigator will accept creative thinking in its broadest sense. If the product produced by the pupil, is new to him, not necessarily to others, the pupil is considered creative. The pupils will be evaluated for the creative thinking with respect to fluency, flexibility and originality.

1.7.3.0 Achievement :

One of the foremost objectives of education is the acquisition of knowledge by pupils, this is also an important objective. Even today the achievement of pupils is considered

a reliable index of the quality of education in our society. However, one of the obnoxious problem of the education in our country is the low level of scholastic achievement of school children.

The students should be tested at the end of the teaching work for how much knowledge they have acquired. This is an important work. For this the proper achievement tests should be administered. The scores obtained at these tests are known as the achievement of pupils. Thus, the term 'achievement' is now not an unknown or unfamiliar word in the educational world. So itisfutile to discuss that point over here and hence the investigator will remain satisfied by simply stating that the pupils will be evaluated after completion of every strategy. The details regarding these achievement tests, developed for this study, are given under caption 3.7.0.

1.7.4.0 Objectives :

The study is an attempt to see the relationship between the processes that is four different teaching strategies and product that is pupils creative thinking and achievement in science.

The general objective of the study is to see the relative effectiveness of the four different teaching strategies namely (i) Strategy I - Lecturing (ii) Strategy II - Lecturing with

Discussion (iii) Strategy III - Lecturing with Discussion and Practical Work, (iv) Strategy IV - Lecturing with Discussion, Practical Work and Use of A.V. Aids Upon pupils attainment on creative thinking tests and achievement tests in science. In short, the study was undertaken to fulfill the following objectives :

(i) To find out the effectiveness of St_1, St_2, St_3, and St_4 on the development of creative thinking ability, of standard VII pupils of Petlad town.

This objective is to be fulfilled by employing Latin Square Design.

(ii) To find out the effectiveness of St_1, St_2, St_3 and St_4 ont the achievements in science of standard VII pupils of Petlad town.

This objective is also to be fulfilled by employing Latin Square Design.

1.7.5.0 Hypotheses :

Keeping in view, the framework of the study, resulting from the critical review of the related literature, the problem and the objectives, some of the following null hypotheses have been formulated :

(i) There will be no significant difference between strategies St_1, St_2, St_3 and St_4 for promoting creative thinking in the pupils of seventh class.

2. There will be no significant difference between Strategies St_1, St_2, St_3, and St_4 for the achievement scores of the seventh class pupils in Science.

3. There will be no significant difference between strategies St_1, St_2, St_3 and St_4 for the development of creative thinking in high or low achievers

4. There will be no significant difference between strategies St_1, St_2, St_3 and St_4 for the development of creative thinking in pupils having high or low intelligence.

5. There will be no significant difference between strategies St_1, St_2, St_3 and St_4 for the development of creative thinking in either boys or girls.

6. There will be no significant difference between strategies St_1, St_2, St_3 and St_4 for developing creative thinking among high or low creative pupils.

1.8.0 Delimitations

The study is delimited to the following aspects :

(i) Teaching is a wide concept and involves a large number of variables, out of which only four variables viz. Lecturing, Discussion, Practical Work and A.V. aids, would be used for developing four teaching strategies as described in caption 1.7.0.

(ii) The investigator would use only verbal tests for measuring creative thinking.

(iii) While developing the different tests, the study restricts to the sample of students (described in caption 3.6.0) for the purpose of validation.

(iv) In the present study creative thinking would be represented by Fluency, Flexibility and Originality of thinking.