CHAPTER- II

CONCEPTUAL FRAME WORK OF THE STUDY

Conceptual frame work is sort of map or way in the light of which research can be done.
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A conceptual framework is a tool that is knowledge based and researchers use to guide their inquiry; it is a set of ideas used to structure the research, a sort of map that may include the research question, the literature review, methods and data analysis. Researchers use a conceptual framework to guide their data collection and analysis. The researcher has to bear in mind that a conceptual framework can overly influence his thought and subsequent actions. If the researcher becomes too bound by the framework then this has to be laid out and acknowledged when he writes up their methodology. The researcher should be prepared to use more than one set of ideas to guide his research, which may mean using two or three theoretical frameworks in conjunction for research.

The proceeding chapter dealt with the theoretical frame work of the problem. The present chapter- II Conceptual frame work is to understand concept of the study and the frame work with understanding of the variables used and their relationships. Discussion in the previous chapter-1 (Introduction) shows that declining position of science education is only because of poor state of science teaching which leads the students bored and low achievers in the subject. The present chapter clarifies better understanding of the study of Instructional strategies and its effects on academic achievement, scientific attitude and creativity.

2.1 STRATEGY

Strategy is a part of teaching which is different from many more activities involved in this process. It is the blue print of teaching which takes into consideration all those activities which are needed to generate educative environment. Edgar Dale (1946) found that individual do remember 10% of what they read, 20% of what they see, 30% of what they hear. Moreover, effectiveness of teaching methods are not credible as learning results depend upon teaching methods or way of teaching. 90% of learning occurs by activity or real experience. Teaching must involve such activities that generate maximum learning. For this teacher must have planned strategy which is to follow while teaching (Edgar Dale, 1946).

Strategy, a word of military origin, refers to a plan of action designed to achieve a particular goal. Strategy bridge the gap between ends and means. Strategy is a term that refers to a complex web of thoughts, ideas, insights, experiences, goals, expertise, memories, perceptions, and expectations that provides general guidance for specific
*Strategic Planning* points out that individual use "strategy" in several different way:
most common being these four:

1. Strategy is a plan, a "how," a means of getting from here to there.
2. Strategy is a pattern in actions over time.
3. Strategy is position; that is, it reflects decisions.
4. Strategy is perspective, that is, vision and direction.
5. Strategy answers the question: What should the organization be doing?

![Think-Done-Plan](http://www.itma.vt.edu/modulesstrategy/spring03/mstrdes/lesson8.htm)

So from the above figure it is very much clear that strategy is a planned action through thoughts.

### 2.1.1 Factors involved in Strategy Building

Retrieved from: [http://www.itma.vt.edu/modules/factors/spring03/instrdes/lesson8.htm](http://www.itma.vt.edu/modules/factors/spring03/instrdes/lesson8.htm)

Strategy building is based on the following factors:
- The educational philosophy of the institution.
- The objectives of the learning situation.
- The learning theories to which the teacher subscribes.
- The observation and feedback plans.
- The modification and improvement of the strategy in terms of feedback.

### 2.1.2 Functions for strategy building

- Selecting sequence of instruction.
- Translating knowledge about students into motivational devices.
- Making abstraction concrete.
Strategies can be classified into two main groups:

2.1.3 AUTOCRATIC STRATEGY
In this type of strategy teacher remains more active and students are passive listeners. Being highly conventional style of teaching it does not consider the students abilities, interests and personality factors. This is also called conventional instructional strategy. It has following strategies:

- **LECTURE STRATEGY**
  It is an oldest and most famous widely used strategy. It lays emphasis on presentation of fully structured knowledge to students. Teacher is more active.

- **LECTURE –DEMONSTRATION STRATEGY**
  'Lecture' means teaching by giving a discourse on some subject and 'Demo' means a 'show' or 'display' the act of presenting something to sight or view. The purpose of instruction is to improve performance of learner by clearly stating the results we want the learners to accomplish.

2.1.4 PERMISSIVE STRATEGY
In these strategies both students and teachers interaction is maximum and both remain active in teaching process. These strategies encourage creativity of the pupils and include following strategies:

- Heuristic strategy
- Project strategy
- Question – answer strategy

These strategies help in learning individual in different situations.

2.2 INSTRUCTIONAL STRATEGY
Effective teaching begins with effective planning. A vital part of that planning includes determining the instructional strategy to be utilized in order to deliver the instruction. Teaching and learning are complementary to each other. For the purpose of promoting learning in students, the learning experiences need to be well structured and presented to the learner in a meaningful way.

*Instruction is the organized system of activities of works towards the realization of certain specific objectives. It is the information received by the mind experiences.* [International Encyclopedia of Education (1990)](http://example.com) considers instructions as an activity or events used by the teacher in delivering curricula to students in lessons and other setting. Instruction is the system involves different components – terms, concept, facts, theories, generalization, rules, principles although distinct in their nature and operation, function in a coordinated
manner contributing to the achievement of goals (Husen, and Postlethwaite; 1990). In an instructional situation the components of the system are input of learning material and various techniques and maxims such as lecture, discussion, programmed instruction, practical work, library work and other teaching aids are used for presentation. Austin (1983) indicated that competency based instructional approach generated more interest in students than did the traditional approach.

Instruction deals with manipulation of conditions of the learning situation with commanding attention with presenting essential stimuli and sequence of direction given to the learner. The synthesis of these sets of activities is called instructional strategies. Instructional strategies determine the approach that a teacher may take to achieve the learning objectives and are included in the pre-instructional activities, information presentation, learner activities, testing, and follow-through. It is something a teacher arranges that is designed to establish interaction between the teacher, student and the subject matter or any combination of these three dimensions. It is the total plan with carefully selected tools, techniques etc to be used in the classroom for optimum outcome. Reigeluth (1983) prescribed that three most important concerns of Instructional strategies are: outcomes, conditions and methods.

- The outcomes are the effects of the methods of instruction, their effectiveness, efficiency and appeal.
- The conditions influence the effects of the methods and therefore influence the selection of methods. They include the nature of the content, the learners, the learning environment and the constraints of the developmental process.
- Methods are the ways selected to achieve the goal.

In other words Instructional strategies are methods, techniques, and skills etc that are used in the lesson to ensure that the sequence or delivery of instruction helps students to learn. It helps to establish interaction between the teacher, student and subject matter aiming at to move student from one point to another end. Gagne (1977) in his comprehensive model for guiding learning suggested that pre-requisites for learning reconnected in hierarchical fashion. For effective instructions learning task should be carefully sequenced. Hence Instructional strategy is the planned sequence of instructional events or activities which help teacher to design his teaching to attain the instructional goals.

It has four phases:

- To identify specific objectives.
- To develop suitable learning material for the objectives.
To validate the workability of the strategy.

To integrate different components to form the instructional strategy.

To provide all round development we need to design a suitable instructional strategy which helps our students grow emotionally, physically, socially, and intellectually (Joyce, 2004). Joyce, Weil & Calhoun (2004) opined that teachers must not only be knowledgeable about the content they teach but must also know and be committed to making decisions that involve the use of a variety of instructional strategies and approaches appropriate to the diverse learning needs of students. Teacher’s interpretation should be based on empirical evidences, past experiences and extensive knowledge of methods and material. Bruner (1995) stated that instruction should consider four major features namely: Predisposition, structure, sequence and consequence. Following guidelines relate these elements to instructional strategies:

- Instructional Strategies should develop the individual’s predisposition to learning.
- Instructional Strategies should be structured so that the learner can grasp the information provided readily.
- Instructional strategies should be sequenced in the most effective manner in order to correlate with subject matter.
- Instructional strategies should be designed with consequence of proper perspective of rewards and punishments. Hence Self energized child will find solving a complex problem intrinsically.

There are main five types of instructional strategies as follow:

- Direct Instructional strategy i.e. Drill and Practice, Mastery lecture or conventional strategy, Demonstration.
- Indirect Instructional strategy i.e. Problem solving, concept mapping
- Interactive Instructional strategy i.e. Co-operative learning, Brainstorming
- Experimental Instructional strategy i.e. Activity-oriented, Field Trips, Games etc
- Independent Instructional strategy i.e. Computer Assisted Instruction, Learning and Activity Package etc.
2.3 INSTRUCTIONAL STRATEGY AND TEACHING METHOD

Method is derived from Latin word which means ‘Mode’ or ‘Style’ or ‘Way’. Thus teaching method is a style of presentation of content in the classroom.

- Instructional strategies are based on the basis of objectives and they help in the modification of behavior of learners whereas teaching methods are selected on the basis of the nature of course content. The course content and its presentation is more important than any other things.
- Instructional strategy considered teaching as a science whereas teaching method considered teaching as an art.
- Focus of teaching is to bring about desirable change in the behavior of the learner. It is brought about by the teacher using instructional strategy to achieve the
objectives. But the teaching methods are used for content presentation; the audio-visual aids are also used in this concern.

Thus, Instructional strategy to be used by the teacher is reflection of what he thinks, what was his past experience, what he consider to be, constitutes an effective instruction for the target population of students.

Harrison, Stewart (1969) examined that different strategies affect the retention rate of an individual differently which clearly shows how effective the strategies are:

- Lecture/ conventional type 5%
- Reading 10%
- Audio-Visual 20%
- Demonstration 30%
- Discussion Group 50%
- Practice by Doing 75%
- Teach Others 90%

Harrison, Stewart (1969) modified a model of Edgar Dale (1946) of Experience Cone of Learning and give the data of retention rate of learning and found that people remember 90%- 95% of the information they teach to others.

![Experience Creates Mastery](http://www.willatworklearning.com/2006/05/people_remember.html)

**Fig. 2.3** Graph showing retention rate (Harrison, Stewart (1969)

Retrieved from: [http://www.willatworklearning.com/2006/05/people_remember.html](http://www.willatworklearning.com/2006/05/people_remember.html)
Above percentage data clearly shows that retention through conventional strategy or lecture method is only 5%, immediate use of learning of what we know through hearing is 10% and if reading is done in the class it is only 10% of the retention rate. Practice by doing means hands on activity or any experimentation leads to 75% retention and to teach others through lecture demonstration creates 90% retention.

2.4 INSTRUCTIONAL STRATEGIES AND LEARNING ENVIRONMENTS
Classrooms are places where teachers and students interact within a highly interdependent environment. At particular times, some types of learning environments have been deemed more appropriate than others. For example, prior to the mid-twentieth century in the United States, environments that kept students quiet and in their seats was the preferred environment compared to later times when more open and active environments were in dominant. Both formal and informal learning emanates from the particular environments that teachers create, and these are highly influenced by the strategies being used. For instance, lecturing creates a tightly structured learning environment where students are expected to listen, observe, and take notes. On the other hand, if the teacher divides students into cooperative learning groups, an environment is created where students are actively engaged and their own interactions is suitable for better learning. So environment should be such which promotes better learning conditions.

2.5 INSTRUCTIONAL STRATEGIES AND LEARNER OUTCOMES
Learning is defined as a process where experience (instruction) causes a change in an individual's knowledge or behavior. Different learning theories propound different perspectives about what is important and how learning occurs. Behavioral learning theories generally view the outcome of learning as change in behavior and emphasize the effects of the external environment. Cognitive and constructivist learning theories, on the other hand, viewed learning as change in cognition and focus mainly on internal mental activity. Instructional strategies used by teachers stem from particular learning theories and in turn produce certain kinds of outcomes. For most of the twentieth century, arguments persisted about which learning theories and which instructional strategies were the most accurate and most effective in affecting student learning. Debates among educators and the general public have surrounded lecture versus discussion; direct instruction versus discovery learning; and phonics versus whole language. These debates led nowhere mainly because the selection of effective instructional strategies alone can not be effective and mainly depend on what the teacher is trying to accomplish. Instructional strategy and classroom situation should be such that maximum learning occurs.
Learning environment should be such in which there is teacher to teach, medium through which the flow of information passes (display board, computer, concrete material etc) and results in maximum learning outcomes as shown in Fig: 2.4. There are some facts which should be under consideration for maximum learning. These are following:

- Dynamic model of teaching (Explore, Adventure, Heuristic method, and project method using A-V aids.)
- Self-discipline and social discipline.
- Cooperative relationship Learning
- Experimental attitude

There are some classroom applications which when applied by the teacher can proved to be helpful in teaching and make it effective.

2.6. CLASSROOM APPLICATION

In the classroom there are certain ways or method through which the information flows. In case of conventional strategies teacher use the book and black board as a medium of instruction. In case of modern science and technology teacher uses computer, L.C.D, projectors etc to transmit the information. There are various strategies which are used in
classroom from earliest time to modern times. But the conventional strategy is now being used as frequently as in past in large part of our country’s schools.

2.6.1. CONVENTIONAL INSTRUCTIONAL STRATEGY

It is the system of education prevailing in high schools that is characterized by an annual system of examination conducted mainly through written mode consisting of essay type of items. The whole process of teaching in the classroom is text-book oriented and focuses on reading and writing. Conventional based instruction or traditional classroom instruction is focused on the instructor and is teacher centered. Most of the information tends to flow from teacher to students. Students are passive listeners. Teacher has authoritarian role and transmit knowledge to the students who are considered as passive receivers. Teacher appears as ‘sage on the stage’. Teaching-learning process emphasizes memorization of facts, formulae, definitions, equations, derivatives, procedures, and theories. Therefore, teaching is examination oriented and its objectives are to prepare students to pass the examination with high marks.

![TRADITIONAL TEACHING SEQUENCE](image)

In the above case of Fig: 2.6.1 flow of information is in one direction towards the learner. This method does not update the knowledge of the students. As activity and technology is not being used and feedback is not taken. It appears that teacher is in the form of Sheppard moving students in one direction as shown in the picture below.
Computer-based model can be implemented on any subject along a continuum of various degrees of automation. Automation assists the teacher in carrying out and managing the process. So based on automation, computer model has three main applications.

- Computer-assisted Learning
- Computer-managed Instruction
- Computer-assisted Instruction

2.6.2. COMPUTER-ASSISTED LEARNING:
In Computer-assisted Learning (CAL), the programs are designed to encourage the gaining of knowledge by finding out learning rather than by drill and practice. The material is presented that a student learns by investigation. In this case often simulation is used.

2.6.3. COMPUTER-MANAGED INSTRUCTION
Here Computer can serve as classroom terminal, assisting the teacher in diagnosing and prescribing a course of instruction for the student.

2.6.4. COMPUTER-ASSISTED INSTRUCTIONAL STRATEGY
Variety in teaching methods adds spice to learning. Teachers need a repertoire of teaching strategies to make their teaching more interesting and therefore, effective. They can present content through a variety of methods and techniques that are passed down to the student-teachers. Computer Assisted Instruction (CAI) has now begun to show promise due to availability of computers in Indian schools. Computer Assisted Instruction is a method of learning in which there is purposeful interaction between a learner and teacher.
Conceptual Frame Work Of The Study

with the help of computer device for helping the learner to achieve the desired learning objectives with his own pace and abilities at his command. It is the interaction between a student, a computer and a teacher for the purpose of achieving educational outcomes through internet blog, e-mail source like e-learning.

CAI is the use of a computer to interact directly or indirectly for presenting lesson content/to display lesson material, reinforce learning, stimulate environment conditions, and provide drill and practice and testing student’s progress in the form of feed back and evaluation to judge how much has been retained. For an instance: in case of branching instruction the computer program issues a piece of information and then raises a question about it. The learner supplies an answer if this response is correct, the program moves on to the next step. Computers provide immediate feedback, letting students know whether their answer is correct. If it is not so ie:- if response is incorrect then the information is presented again and the program shows students how to correctly answer the question and retest. Effectiveness of any instructional material depends on other various organizational and demographic factors also. Such variables are like: study habits, place of residence, aptitude, learning style and attitude etc.

Because of computer’s flexibility and capacity to provide branching instruction, it can assume the guidance role of a potential teacher or instructor, while also providing students with necessary reference material in simulated laboratory facilities. Computer programs are interactive and can illustrate a concept through attractive animation, sound, and demonstration of experiments. Teacher may use the CD’s, video clips, virtual field-trips, virtual science museum. Computers offer a different type of activity and a change of pace from teacher-led or group instruction. Computer assisted Instruction is an interaction between a students, a computer controlled display and a response entry for the purpose of achieving educational outcomes. Available Computer educational programs allow students to progress at their own pace and work individually or solve problem in a group. Students develop critical thinking skills, problem solving experiential learning and interdisciplinary knowledge, with technology being integral to their learning (Cook & Cook 1998; Oliver, 2000). D’souza (2002) reported that today 85% of the contents are available in the form of electronic books. To know how much students learn with computer it is essential to know how effective teacher can teach with the help of computer. Strategies based on computer technology are e-learning, web-based learning, CD-ROM, internet etc which help as an instructional tool, where students are active learners, involved in construction of knowledge in learning process. Student use word processing software or e-mail to share their understandings with student peers as well as teachers. This use of technology can be used to improve student’s writing skills, produce better ideas for decision making.
Computer technology can help to make student's thinking processes more deep and clear, indirectly visible to the teacher through students’ performance (Bennet, 1986).

**Some important computer technologies to be used by the teachers and students to help in instructions are:**

- **E-learning technology** by which can create electronic-media applications as part of their project requirements. This would make them active participants in their own learning process.
- **Multimedia mediated** learning process students are able to use various media forms to present information, thus helping them to improve their presentation skills and communications styles, which are very important in the workplace today.
- **CD’s of lesson, video clips, documentary, virtual field-trips**
- **Internet, on-line discussions, quiz, feedback of work, drill and practice.**

Hence with the use of these technologies students can be motivated in their study and they learn to apply what they have learned previously in solving authentic problems. Therefore computer technology as instructional strategy is used to facilitate construction of knew knowledge. Following pictures can clear the interest of the students when they are engaged.

Retrieved from:
http://www.google.co.in/search?q=photos+of+students+learning+through+quiz/09/2010/html
2.7 EFFECTIVENESS AND OUTCOME OF COMPUTER ASSISTED INSTRUCTION (CAI)

Computer Assisted Instruction (CAI) can increase a student's access to information. The program can adapt to the abilities and preferences of the individual student and in the amount of instruction that a student receives at his pace and will. Computer-based experiences often engage the interest of the students, motivating them to learn, incr...
Conceptual Framework Of The Study

independence and personal responsibilities for education. Numerous studies have been reported that CAI is successful in raising examination scores, improving student's achievement, attitudes and lowering the amount of time required to master certain material. There is substantial evidence that CAI can enhance learning at all educational levels. Douglas (2000), stated especially those involving abstract reasoning and problem-solving processes, CAI has not been very effective. Critics claim that poorly designed CAI system can regiment the educational experience and thereby diminish student interest and motivation. Other student's failures can be traced to inadequate teacher training in CAI system. Although much efforts has been directed at developing CAI system that are easy to use and incorporate expert knowledge of teaching and learning. Learner and computer can be engaged in the learning process. The learner becomes intellectually involved and has the opportunity to grow without a great deal of teacher stimulation. The computer is versatile in regard to videotape players, electronic, musical equipment, physical education monitoring equipment and so on. It becomes an invaluable teaching tool on both personal and collective scale (Biswas, 1994). In whole a good quality CAI programme develops interest among students and motivate them to learn more.

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So for better learning and understanding the subject matter by the students it is very important to motivate them properly. Motivation to learn plays an important role in learning achievement and in the change of student’s behavior after training. Self efficacy has been shown to influence the behavior of individuals towards the execution of actions. Moreover, self efficacy is an individual’s belief about his or her capacity to mobilize the resources requisite for successful task performances (Bandura, 1986). The degree to which an individual believes in using a particular system would enhance his or her job performance. (Davis, 1989). Perceived usefulness, influence positively the effectiveness of e-learning. So the motivation, computer self efficacy, perceived ease of use and perceived usefulness were recognized as possible factors that explain learning outcomes.

2.8. COMPUTER ASSISTED INSTRUCTION (CAI) AND CREATIVE THINKING

Divergent thinking is a pre-requisite of creative thinking. Teaching with the use of CAI can enhance divergent thinking. CAI can include brainstorming and problem solving ability of the students. Salomon (1989) stated that these are not only interactive instructional devices but also useful tools that extend in many important ways to our mental capacities. Further they serve as possible models for certain kind of thinking that helps in learning and could use to discover powerful ideas with, as well as emulate, internalize and use as newly acquired mental tools. Papert (1980) developed a computer language “Logo” which is a primary example of an application of constructivism based on micro worlds. Papert stated that it should meet four criteria, usefulness, generality, simplicity and being syntonic (moving from known to unknown). He believed that computers with suitable software could promote syntonic learning by providing children which extended opportunities to explore aspects of the world previously unavailable to them.

Knight and knight (1995) asserted that computer have a valuable role in teaching children to think. As they reported there is currently much to support the notion that children need to be encouraged to think critically about information, solve problems and reflect. According to Biswas (1994) computers have excellent potential for abstract thinking because the learner can compare relationships in reference to computer games as well as the concepts involving such an academic area as biology, economics and physical education. These arguments raise question of computer could serve not only superb instructional devices but also as unique cultivators of mental skills and strategies.
2.9. ACTIVITY-ORIENTED INSTRUCTIONAL STRATEGY

Tell me and I'll forget
Show me and I might remember
But involve me and I will understand

By- Professor Hossein Arsham

Activity Oriented Instructional strategy is "anything that involves students in doing things and thinking about the work done"

In activity-oriented instructional strategy, the teacher is mostly a facilitator rather than an authority in knowledge. He engages the learners into tasks and makes abstract ideas into concrete ones. It is learning by doing rather than learning by listening. It can be done in two ways: i) Student centered instruction; where students have freedom to choose a problem and formulate strategies to solve them and ii) Teacher centered instruction; where the teacher takes the leading role. Activity oriented Instructional strategy is based on the belief that the students learn best when they gain knowledge through exploration and active learning. It is a process of exploring, experimentation, observation, data collection, analyzing, and justification communicating, using new information or experience. It is a process whereby learners are actively engaged in the learning process, rather than "passively" absorbing lectures. Activity-oriented Instruction is a natural extension of the constructivist and situated approaches to learning and its essence is to actively engage learners in authentic learning activities. It puts learners in the kinds of situations in which they need to use those skills. According to Silberman (1996) when learning is active, students do most of the work. They use their brains for studying ideas, solving problems and applying their knowledge to what they learn. Activity oriented instruction is fast-paced, fun, supportive and personally engaging. It involves putting our students in situations which compel them to read, speak, listen, think, explore deeply and write. Hands-on materials are used instead of text-books and students are encouraged to think, rationally, logically, critically and explore & explain their reasoning instead of memorizing and reciting facts. The teacher guide or instruct to provide structured activities that will help the students, step by step, until they have mastered the teacher selected goals. The teacher changes from authority to facilitator by finding ways to present the subject matter that is based on fun and enjoyment.
Various types of games are included such as:-

- **Experimental** games/project for the development of senses such as observation, exploration, try to destruct and rebuilt the things.

![Making Electronic Models](http://www.google.co.in/search?q=photos+of+students+learning+through+virtual+files%2C+quiz%2C+documentary/2010/html)

- **Constructive** games in which child tries to construct things like painting, toys, models, improvised apparatus.

![Constructive games](http://www.google.co.in/imgres?q=activity+based+instructional+strategies&hl/en)

- **Movement and motor games for play**, for physical development joining 1 parts etc.
- **Imitation is a type of game to play** includes artistic activities, drama recitation etc.
Artistic activities

Retrieved from:
http://www.google.co.in/search?q=photos+of+students+learning+through+virtual+field+trips%2C+quiz%2C+documentary/html

Many types of activities like:-
  - Collaborative/ cooperative learning
  - Problem – based learning
  - Case method, jigsaw learning
  - Course projects,
  - Simulations and technology

In this type of instruction the learner have academic freedom. Learner think, observe, experiments, discuss, verify, evaluate, reflect and thus gain new knowledge during process.

Once children understand and enjoy the games, they will create games for themselves and others. Activity whether through play or through games created for learning, children automatically remember the subject involved. Just because children and teachers are enjoying the games does not mean that the subject matter gets lost; on the contrary, the subject matter is the starting point. In this the learners have academic freedom. Learner think, observe, experiments, discuss, evaluate, reflect and thus gain new knowledge during process.
2.9.1. Advantages of Activity-oriented Instruction:

- The most important feature of activity based instruction is learning by doing. So this method of instruction can fulfill the natural urge of a growing child on one hand also can help them learn their lesson.
- This method also promotes better understanding of a lesson among students as they learn the lesson by practicing the task themselves.
- It inspires the students to apply their creative ideas, knowledge and minds in solving problems as well as promoting competitive spirit among them.
- It also helps learner psychologically as they can express their emotions through active participation in something useful.
- This method also helps in developing their personalities, social traits and interpersonal management skills.

2.10. CONCEPTUAL UNDERSTANDING OF VARIABLES

Conceptual understanding of the various variables considered in the present investigation in order to understand the rationale of the relationship of these variables with independent variables of instructional strategies.

2.10.1 ACHIEVEMENT

One of the responsibilities of teachers has always been to measure the results of their teaching efforts so far as they are reflected by the progress and in the mastery of the
subject matter. The accomplishment in the school work that is curricular and co-curricular is called achievement and tests that measure this achievement are called achievement tests. Analysis of achievement tests enables the students and teachers to understand their strength and weakness as a result of which they can improve their learning. 

Achievement means the extent to which learning is maximized from instructions in a given area of learning and the extent to which learning and study has resulted in mastering. It is the outcome of general specific learning. Berger (1993) stated that achievement encompasses student ability and performance. Travers (1959) coined that term achievement refers to any desirable learning that occurs. It implies value judgment. It is obvious that whether a particular learning is referred as an achievement or not depends or not. 

Achievement means the extent to which a learner is profiting from instruction in a given area of learning (Crow and Crow, 1969). In other words, achievement reflected by the extent to which a person, form the training imparted to him, has acquired skill or knowledge. It is the outcome of general and specific learning experience. Achievement is a thing done successfully especially with efforts and skills (Oxford Advanced Learners Dictionary, 1987).

2.10.2. Factors affecting Achievement

The difference in the level of Academic Achievement to large extent can be attributed to different levels of receptivity in children. There are two classes of factors which affect the achievement:

- **Subjective factors**
- **Objective factors**

**Subjective factors**

These are related to individual himself. These are:

- Intelligence
- Creativity
- Learning ability
- Aptitude
- Self- concept
- Study habits
- Motivation
- Level of aspiration
- Social and Emotional adjustment
Objective factors
These are related to the environment of individual
- Socio-economic condition
- Teacher's personality
- Training attitude
- Medium of instruction
- Educational facilities
- Evaluation system
- Family environment or school environment
- Psychological environment
- Number of students

2.10.3. ACADEMIC ACHIEVEMENT
Academic achievement refers to the scores obtained in the annual examination or refers to the degree or level of success or proficiency attained in some specific area, concerning scholastic or academic work. Trow (1969) defined academic achievement in any subject as attained ability or degree of competence in school tasks usually measured by standardized tests and expressed in age or grade units based norms derived from wide sampling of pupil’s performance. So it is the status or level of person’s learning ability to apply what he has learnt. It is concerned with the quantity and quality of learning attained in a subject of study. It encourages the students to work hard and learn more. Biswas and Aggarwal (1984) coined the term academic which means pertaining to school subjects or to the field of liberal arts or to the sphere of ideas and abstractions. Megargee (2000) emphasized achievement test show how well students have mastered the subject matter in a course of instruction. It is a multidimensional and multifaceted phenomenon.

2.10.4. ACHIEVEMENT IN SCIENCE
Science achievement refers to the degree or level of success or proficiency attained in some specific areas concerning science. In general it refers to the scores obtained in the annual exam of science. It is measured and assessed by achievement test and compared to the set norms to evaluate an individual performance.

2.10.5. ATTITUDE
Attitudes are important keys in understanding the long range organization of behaviour. The prominent role of attitudes in determining our thoughts, memory and learning process has been recognized by various psychologists.
Good (1973) said that attitude is readiness to react towards or against some situations, persons or things or resentment to particular degree of intensity. Attitude is a term, which has been described as the way of reaction of a subject upon any impression received from his environment.

According to Sorenson (1977) an attitude is a particular feeling about person, idea or object. It therefore involves a tendency to behave in a certain way in situations and is partially rational and partially emotional and is acquired, not inherent in an individual.

One of the terms describes attitude as it is a specific mental state of the individual towards something according to which his behavior is moulded.

An attitude is a hypothetical construct that represents an individual's degree of like or dislike for an item. Attitudes are generally positive or negative views of a person, place, thing, or event-- this is often referred to as the attitude object. People can also be conflicted or ambivalent toward an object, meaning that they simultaneously possess both positive and negative attitudes toward the item.

Allport (1935) has defined an attitude as a mental and neural state of readiness organized through experience, exerting a directive or dynamic influence upon the individual's response to all objects with which it is related. Attitude results from personal desires and group stimulation. They actually are a part of individual's own personality. An attitude is a complex affair which cannot be wholly described by any single definition. He opined that an attitude toward science refers to the feelings, opinion, beliefs in and about appreciation that an individual forms as a result of interacting directly or indirectly with various aspects of scientific enterprise and which exerts a direct influence on their behaviour towards science.

Crow and Crow (1969) further stated that attitudes are personal and related to feelings of a person. Attitudes are uniquely organized in each person. Like other aspect of personality, attitudes are acquired and not innate. No one is born with an attitude; they are learned in a culture in course of individual's development.

2.10.5.1 Dimensions of an Attitude

Universe has three dimensions but attitude has four dimensions as it is never stable and is changeable according to situation.

So the four dimensions are:-

- Intensity
- Extensity
- Duration
- Direction
Each of these aspects is important in understanding attitudes and their influence upon behavior.

- **Intensity**
  Intensity of an attitude is evidenced by the extent to which it motivates an individual's behavior. Limits of intensity can be determined by the nature of the barriers needed to inhibit a response. An intense attitude is likely to find expression in behavior despite all overwhelming obstacles.

- **Extensity**
  Extensity is observed in a broad survey of the pattern of an attitude within the individual. Some attitudes seem to have broad and pervading influence. A single potent incident of a sort that can be generalized may bring about an extensive influence.

- **Duration**
  Duration of an attitude is another aspect that is important to education. A function of education is the modification of existing negative attitude and the creation of new ones that are positive and enduring.

- **Direction**
  Direction of an attitude is evidenced by area or side by which an individual’s behavior is modified.

### 2.10.6. FACTORS INFLUENCING THE DEVELOPMENT OF ATTITUDES

- **Maturation**
  Mature person may have positive attitude and is able to resolve the problem.

**Physical Factors**
Attitude is affected by malnutrition, diseases and accidents etc

- **Home Influence**: Malnutrition at home or disease may cause negative attitude.
- **Social Environment**: Attitude variations may be due to stereotype society or orthodoxy people, prejudices or biases etc.
- **Cognitive Factors**: this may be due to intelligence, creativity and achievement of child.

### 2.10.7. SCIENTIFIC ATTITUDE

Education is the main instrument for any social and scientific change. Educational committees, commissions and policies have identified the place and importance of science education. It is only through development of scientific attitude among the students, teachers are able to develop the all round personality of the students. Scientific attitude is one of the key objectives of science teaching. It helps the people live up to their...
expectations and satisfactions. Comte (1968) had defined scientific attitude as the highest level of intellectual insight. Scientific attitude is a condition of readiness for a certain type of activity. Aim of science teaching is to develop and inculcate scientific attitude in the students. Removal of false belief with logical method, curiosity toward surrounding environment, cause and effect relationships, patience, love for justice etc are the qualities of 'scientific attitude'. A vitalized study of science with emphasis on tolerance, open-mindedness, rational outlook, suspended judgment leads to development of scientific attitude. Vaidya (1971) stated scientific attitude is a set of emotionally toned ideas about science and scientific methods and is related directly or indirectly to a course of action. Kurz (1976) defined that scientific attitude is a belief and is true if and only if it has been confirmed, directly or indirectly, by references to observable evidence. Scientific attitude includes freedom from bias, prejudice and superstitions, open-mindedness, critical thinking, intellectual honesty and beliefs. John Dewey (1933) stated that scientific attitude is linked with, curiosity, fertile imagination and tone of experimental inquiry. Ausekar (1995) had defined scientific attitude as open-mindedness, a desire for accurate knowledge, confidence in procedures for seeking knowledge and the expectation that the solution of the problem will come through the use of verified knowledge.

2.10.8. COMPONENTS OF SCIENTIFIC ATTITUDE

- **Critical mindedness** (looks for consistency and challenges the validity of statements)
- **Suspended judgment** (recognizes the restricted nature of evidence and concepts)
- **Respect for evidence** (looks for evidence through an empirical approach)
- **Honesty** (reports all evidence and acknowledges the work of others)
- **Objectivity** (considers pros and cons and all of the evidence available—unbiased)
- **Willingness to change** (alters hypotheses, assumptions, technologies and methods)
- **Openmindedness** (considers several possible alternatives when investigating)
- **Questioning attitude** (asks many questions: how, what, who, where, when and why?)
- **Tolerance of uncertainty** (rejection of certainty)

➢ **Other components of Scientific Attitudes**

- curiosity
- looking to be creative
- appreciation for beauty
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- appreciation for complexity
- appreciation of unity (synthesis of concepts)
- perseverance

Srivastava (1980) had given major components
- Commitment to the value of rationality.
- Tendency to test traditional beliefs.
- Seeking natural course of events and identification.

Science teacher should make special efforts to develop scientific attitude by using effective instructional strategies in the class. Strategies help in development of critical thinking, curiosity to study the concepts, formation of ideas and construction of models that leads to development of scientific attitude.

2.11. OBJECTIVES OF SCIENCE TEACHING AND SCIENTIFIC ATTITUDE

A report of school science teaching by Rai (1960) states the main objectives for science teaching and scientific attitude are:
- To arouse the curiosity of students about the world we live in and to encourage him to understand the various phenomenon.
- To train to acquire the habit of making observation in a planned way.
- To develop in him scientific attitude.
- To give him an idea how a scientist works.

The aims and objectives of teaching general science according to All India Seminar (1992) on teaching of science were:
- To familiarize the pupil with the world in which he lives and make understand the impact of science so as to enable him to adjust.
- To acquaint him with the scientific method and enable him to develop scientific attitude.
- To give pupils a historical perspective, so that he may understand the evolution of scientific development.

National Policy on Education (1986) states that science education will be strengthened so as to develop in the child well defined abilities and values such as the spirit of enquiry, creativity, objectivity, the courage to question and aesthetic sensibility.
2.12 CREATIVITY AND ITS IMPORTANCE

"Creativity is not the finding of a thing, but the making something out of it after it is found."

--James Russell Lowell

Creativity involves generation of new ideas. It is the capability of producing new solution in the intellectual way to solve problems. In other words it is bringing into existence something new. Beyond intelligence, there must also be ‘wisdom’ because intelligence alone is not sufficient (Sternberg, 2001). A creative and intelligent person may produce a novel idea, but without wisdom, the novel idea may be ‘foolish’ or inappropriate (Sternberg, 2001).

Invention and creativity are essential for progress of society and making the life more meaningful. So there is need to orient students in creative thinking. Young people face tremendous challenges for the future which include reduction of natural resources and enhancing problems to everyday life. So investigation on how effectively to stimulate student’s inventiveness of creativity is important and a worthwhile research endeavour before the society.

Creativity is essentially a human phenomenon. It is a process in man which helps him achieve dignity and meaning in life. Creativity is marked by the ability or power to create, to bring into existence, to invest with a new form, to produce through imaginative skill, to make or bring into existence something new (Webster’s Dictionary, 2006). Carl Rogers (1961) viewed that it is emergence of a novel, relational product, growing out of the uniqueness of the individual. Creativity is considered to be identical with the expansion of the universe and the main task of man on this planet. Whether it is considered from the viewpoint of its effects on society, or as one of the expressions of the human spirit, creativity stands out as an activity to be studied, cherished and cultivated. Arieti (1976) stated in one form or another, there is a world-wide trend which shows great concern about creativity. Advanced countries are definitely interested in the study and development of creativity, as are third world countries, whose survival depends upon the creative vision and creative striving of the masses. Arieti (1976) surveyed 133 studies and opined that in most of the studies, preciseness, clarity and maturity of judgment were conspicuous by their absence. Raina (1980) stated that human creativity may prove to be the key to success or failure in mankind’s quest for knowledge, in his journey beyond the bounds of the certain and the seen, in his exploration of the unknown. Barron (1968) & Gupta (1974) surveyed the field of creativity in India and referred to 76 studies at various
stages. Analysis showed that a majority of research had been done in area of personality in relation to creativity while other areas like mathematical creativity, scientific creativity, and literary creativity remained to be investigated adequately.

Any original thinking, which is systematically led to a useful new idea that can be scientifically tested and generalized, becomes a scientific creative thinking. When scientific creative thinking habituated, it becomes scientific creativity. Creativity of any kind, involves an active interaction of the creative person with his environment. Spearman (1931) viewed creativity as the power of human mind to create new content by transforming relations. Mackinnon (1962) pointed out that true creativity involves a response or an idea extended in time and characterized by originality, adaptiveness and realization. Isaksen et al (1993) opined creativity is a multifaceted phenomenon that results in production of new and useful ideas. It is the research of interactions among several components of creativity such as person, process, product and press. Taylor (1964) stated that a process is creative when it results in a novel work that is accepted as tenable, useful or satisfying by a group at a point in time. Dagar (1989) writes that of all the abilities that man as 'Homo sapien' is endowed with, creativity is perhaps the most "unique". Dagar (1989) coined the term as a product with attributes like novelty, originality etc, while others delineates it as a process which results in a unique product. Lytton (1971) stated the 'creator ' par excellence is God and whenever we create some new things, we feel we are God – like and achieving immortality. Creativity in this sense, is an attribute of God, and therefore, obviously, beyond description in clear terms. Guilford (1960) termed it many splendor things. While Mackinnon (1962) called it a many faceted phenomenon. This is the reason why in spite of rapidly increasing volume of literature on creativity, this area of human functioning is still beset with so many difficult problems relating to its conceptualization. Taylor (1975) emphasized it as the development of some new product. Spearman (1930) defined creativity as the power of human mind to create new content by transforming relations and thereby generating new correlates. According to Rogers (1961) it is the emergence of novel relationships. Guilford (1960) conceptualizes creative thinking as clearly involving what he categorizes as divergent production. For Thurstone (1962), in creative act there is a moment by insight but before insight becomes focal there has always preceded a non-verbalized pre-focal thinking. To him, the pre-focal is followed by explicit and deductive thinking. Arieti (1976) viewed that creativity as a process that involves a 'magic' synthesis of primary and secondary process cognitions. He calls it a tertiary process. From the brief survey of definitions of creativity attempted here, it
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becomes clear that creativity has been viewed in large numbers of perspectives and from different angles. Inspite of all divergence and difficulties in defining creativity, there is perfect agreement over its value and importance. It is viewed as a characteristic ability of man which is very distinctive of him in comparison to other forms of life. The entire human heritage, accumulated in the form of culture and civilization, reveals the role that creativity has played or is playing in adding to the already existing storehouse of knowledge.

Barron (1969) opined that societies cannot be easily and radically changed by the human will but according to plan, rather it is the creativity with which the members of a society are endowed that accounts for the internal dynamism of a society. Man's current degree of enlightenment and vast production of material goods can be traced, in a large measure, to the creative performance on this planet. In the light of the preceding observations, it is obvious that creativity is an important quality and asset of mankind and it must be identified, nurtured and encouraged. With the ultimate goal of helping the potentially creative individuals in actualizing their talent, it must be seen that creativity plays an important role in diverse human activities including teaching. In view of the above the investigator decided to include in the objectives of the study that of determining the relationship of creativity and with teaching.

Perspectives of Creativity:

- Creativity means numerous things to different people and can be defined in any number of ways.
- It is a divergent thinking, usually include the ability elaborate and think of diverse and original ideas with fluency and speed. eg.: Brainstorming is an example of this type of thinking.
- In creative production both thought processes are necessary as one first diverges ideas in numerous quantity and then narrows and refines the array through convergence.
- Creativity is considered as a product, a process, mental abilities and a personality dimension.

2.12.1 Creativity as a Process:

Creativity is considered to be a process. A major portion of it is organized around the areas of thinking and problem solving. Creative thinking has been regarded basically as a process of seeing or creating relationships. It comprises the processes of discrimination from many alternative possibilities and that of synthesizing elements in altogether new and...
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original ways. According to Gordon (1982) the term creativity can be used to describe the basic openness to closure process common to the act, personal growth with which this process unfold, it involves taking in information, analyzing it, synthesizing it, evaluating the synthetic configurations, utilizing the most appropriate synthetic form and responding to environmental reactions to this utilization. Wallas (1926) and Patrick (1955) also considered creativity as a process. They have identified four steps involved in the creative process - (i) preparation (ii) incubation (iii) illumination and (iv) verification

i) Preparation consists of investigation of sources, understanding of background, purposeful study and questioning, experience and absorption of information that fill the gaps that the creative individual perceives. It also includes identifications of a plan for completion. It should be very clear that creativity is ninety nine percent perspiration and one percent inspiration.

ii) Incubation process includes time for (a) relaxation (b) assimilation of ideas into the thought process (c) rearrangement of information and (d) various ideas to rise to a central place. This process leads to reorganization of one's previous ideas to adjust to the new information acquired by preparation.

iii) Illumination is the stage when the time devoted to preparation and incubation is rewarded by a clear conception of the answer to the problem. It is the 'Aha' experience that arises from the formulation and reformulation of relationship leading to solution. It may be a sudden flash of an idea or solution in dream which arises due to correlation of distant relationships that ultimately indicates answer to the problem.

iv) Verification is the validation or confirmation of the solution obtained as a result of illumination in real life situation. After confirmation, the result may be generalized and extended to other situations.

2.12.2. Creativity as Product:
Creativity is thought to be embedded in the product rather than in the process. It is a creative process when it results in a novel work (the product) that is acceptable as tenable, useful or satisfying by a group at point of time. In other words, creativity is the quality which leads to the production of something new desirable. Products of creativity may include elements such as theories, inventions, painting, carvings, poem etc. These products to be creative, essentially involve an element of uniqueness or novelty which implies newness, freshness and inventiveness.
2.12.3. Creativity as Mental Abilities:
Creativity is also defined in terms of certain mental abilities. Gatzel and Jackson (1962) found that creative ability and intelligence are not synonymous. Guilford and other recognized authorities believe that divergent thinking is the most important mental process which reflects the creative ability in a person. Following factors that are involved in divergent thinking:-

i) Flexibility - ability to suggest ideas of different categories provide diversified solution to a problem - thinks different possibilities. The individual is free from inertia or any preservation.

ii) Fluency - fertility of ideas: the individual is quick in thinking new ideas.

iii) Sensitivity to problems - finding defects, deficiencies, needs, the odds, and the unusual and seeing what must be done. The individual is sensitive for the existence of the problem and tries to find out possible solutions.

iv) Originality - suggestions different from others, new ideas, finding remote relationship in ideas, things or time.

v) Elaboration - ability to work out the details of an idea, plan or outline.

vi) Redefinition - finding new uses of familiar things; ability to establish, define or perceive in a way different from the usual.

2.13. NATURE OF CREATIVITY
To an architect creativity is the ability to produce new forms and new approaches and new materials in the functional design. According to Mathematician creativity is the ability to solve mathematical problems which are useful in creating combination and that provide knowledge of mathematical law/principal. According to scientists creativity is the ability to explore ways of extending the frontiers of knowledge. Torrance (1962) conceived creativity as a process of being sensitive to problem, deficiencies, gap in knowledge, missing elements and so on, identifying the difficulties, searching for solution, making hypotheses, testing and retesting these hypotheses and possible modifying them and finally communicating the results. To sum up, creativity is the process, this process is goal oriented which leads to the production of something new ideas (may be verbal or non-verbal, concrete or abstract, may be artistic or in other area of life). In other way it is a specific way of handling information. Further there is variation in creativity of the individual. Environment has great influence on the development of creativity. Similarly sex difference, socio-economic status of parents, family size, urban-rural differences,
scientific attitude, intelligence etc all have lot of influence on the development of creativity including achievement in science.

2.14. CREATIVITY AND SCIENTIFIC ATTITUDE

In order to facilitate science learning a scientific attitude has to be developed amongst children who may otherwise be disinterested in class teaching. This can be done by providing practical applications of theoretical facts. By demonstrating the appropriate practical experiments, reasoning can be given to the children who will promote their interests in the subject. Science students, from their elementary stage, should be encouraged for an inquisitive behaviour as to why and how the things are happening. Snubbing these children will snub their upcoming talent which will ultimately reflect their teacher's personality. So the success of teaching science depends on how far the teacher is successful, through his teaching, in inculcating a scientific attitude. It also predicts the teacher’s respect for scientific values as it enhance the ability to understand laws and concept so as to make use of those in solving daily-life problems.¹

Creativity and scientific attitude are to be nurtured and nourished in our class room. It requires complete involvement of the students in the subject, welcoming their ideas, providing them which an intellectual atmosphere - free to do experiments, observe, think, discuss, infer and express. Scientific attitude is developed by involving students in practical, helping in innovative ideas and encouraging in improvisation of science apparatus, discussion, observation experimentation etc. Creativity in same way is referred to as divergent thinking instead of convergent, which means students can think over new ideas having so many solutions of a single problem. It is a wider thinking over the problem. Hence scientific attitude and creativity are two sides of the same coin and go side by side and we can say if there is development of a scientific attitude among students, there will be automatically development of creativity among students.

India should produce such students who, with their creative mind, will help the nation to survive in international competition and that can be possible by encouraging and supporting the persons with a creative attitude in the society. It is because of this reason that a country like Japan occupies a very prestigious position in the world, as the Japanese come up with original ideas.

2.15. CREATIVITY AND SCIENCE EDUCATION

The unique quality of human beings to design or to give a concrete shape of his imagination helped him to come out from his primitive stage to a position where he dominates over his surroundings. The unique quality of human being, we are referring, is
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known as creativity. Creativity has probably been as important as any human quality in changing history and reshaping the world. Science education and creativity has close relationship with each other.

Science education provides the bases for creativity. The innovation of science and technology helps to provide divergent ideas to the scientist to discover and invent things which leads to enhancement of creative thinking. Present day discoveries and technology is the result of creativity which is possible only through science education. UNESCO (1974) is positive in its stand that both knowledge and creativity are useful in itself but they are also indirect contributors to international understanding and peace. Rapid advancement in science and technology has increased the need for further innovation, challenge to inventions, psychological discoveries of nature of individual differences and emphasis on actualization. This has resulted in an increase in interest for the creativity aspect in the past decades.

In this rapidly changing world, the cultivation of a creative personality, with sensitivity and awareness for environmental problems, is not only important but is also of immense urgency. Creativity can be nurtured through science education in the school and out of the school. According to Chambers 20th Century Dictionary, the word 'Creativity' refers to state or quality of being creative, ability to create. Here creative means having power to create, showing or pertaining to imagination, originality, and create means to bring into being or form out of nothing, to bring into being by force of imagination, to make produce or form, to design, to be the first to act. However, creativity could not fetch a single definition because different thinkers consider it from different perspectives. Morgan (1953) published a list of 25 definitions of creativity. All these definitions indicate that creativity involves development of something unique by the individual. Creativity is not restricted to some particular content. An individual may be creative in painting a novel picture, composing a new symphony or inventing a scientific theory. Torrance (1983) supported the views that the process of creativity is similar to the steps in scientific method. According to Jung (1989) scientists and mathematicians are very creative people and can be classified as judges. Science education which really means to make a person to identify the problems around, to observe, to analyze, to make hypothesis, to experiment, to infer and to generalize and to apply the acquired knowledge and skills where required. It is envisaged in the National Policy on Education of India (1986) and also in the Kothari Commission report (1966) that science education should be for all up to secondary level in order to develop scientific temper amongst the masses. Science education provides field
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to a person, to create something new, for the society and for the nation. Although creativity is not related to any particular subject area, but science education has much wider scope of fostering and encouraging creativity. Thus, science is a process as well as product, involving all the components of creativity, influencing every sphere of life.

List of open competencies which science teaching-learning can help develop:

- Understanding and using: Concepts, laws, principles, formulas, symbols and signs.
- Way of thinking: Deductive, Inductive, Convergent, Divergent, Intuitive, Imaginative and Creative, Analytical and Synthetical.
- Attitudes: Such as patience or tolerance for differences and disagreements from others, self-reliance etc.
- Values: Such as understanding science as the creation of cooperative work, seeing science as an approach to solve human and social problems.

2.16. TEACHING AND CREATIVITY

Effective learning take place when pupils are actively involved in organizing and finding relationships in the information they encounter rather than being the inactive recipients of teacher delivered bodies of knowledge. This activity results in not only increased learning and retention of content but also in improved thinking skill. Educators are recognizing that it is no longer sufficient to simply teach students what they should know, but in addition they must be taught how to know. Creativity can be defined as creative self-direction, which means a level of learning that extends cognitive and affective conceptualization to generate self-determined experiences that are creative for the individual. Teachers can arrange their lessons so that divergent thinking and learning are likely to occur.

2.17. SCIENCE TEACHING AND CREATIVITY

Science seeks knowledge and understanding of the world and of life itself by a method which consist essentially of careful observation and classification of phenomenon, of experiment and of the formulation of so-called laws which summarize our knowledge of groups of observed facts. Teaching of any subject at school is usually justified or defended for cultural, disciplinary and utilitarian reasons. Science can justify its inclusion in the curriculum on each of these grounds. Science teaching in a school has two fold functions to perform. It must give the student a systematic training in careful observation, in experiment and in the estimation of the relative value of results. It must provide knowledge of material world and of the forces of nature for all. At the same time, for the small proportion of pupils who will later become scientists, it must lay a sound foundation.
for more advanced work. It is considered that science requires exact and accurate observation, care and thoroughness of technique, the logical interpretation of data and the intelligent estimation of the reliability of results. The contribution to development of such desirable qualities in students should be a conscious aim of the teacher. Science teaching, when going on in a class, in its ideal form, should be full of activity and be with maximum involvement of the students. By maximum involvement, it is meant that students are using all of their senses in finding solution of a problem. Possibly no hint or suggestion has been given by the teacher to find this solution. Maximum involvement occurs when one is cognitively and effectively absorbed totally in solving a problem. The best way to help a child in doing that is to allow him to work as an independent investigator. A creative classroom, from this point of view is one in which thinking is valued far more than memory, in which a child is expected to make some contribution that is valued and respected. The teacher acts only as a facilitator and not as the ultimate authority with one right answer. Here the teacher is the guide, the prompter, the change-agent.

There are many studies dealing with the relationship between creativity and other psychological constructs but there is hardly any study giving relationship of teaching science and creativity to find out the learning outcome or achievement. In present study investigator tried to find out the effect of instructional strategies in relation to the academic achievement, scientific attitude and creativity.

Above discussion helps the investigator to achieve the target as there is not any study which has compared and checks the effectiveness.