Chapter 1

1.0.0 Conceptual framework

Education in the present day is perhaps one of the most important means for individuals to improve their personal endowment, build up their capacity level, overcome constraints and in the process, enlarge their available set of opportunities and choices for a sustained improvement of quality of life. Education has the power to transform lives. It broadens people’s freedom of choice and action, empowers them to participate in the social and political lives of their societies and equips them with the skills they need to develop their livelihoods. In this process education enhances human capital, productivity and empowers people’s capacities in the process of acquisition, assimilation and communication of information and knowledge. The role of education to meet basic learning needs of every person (child, youth and adults) and in shaping human development have been emphasized through several cross cultural studies. Education is a process through which human personality develops.

The main aim of education is to produce the desired changes in the behaviour of children and when those changes have taken place, we say that the child has learnt. Every moment we gain new experiences. These experiences and traits bring change in our behaviour. Education is the process of gaining these experiences. The concept of life-long process was given by UNESCO in its meeting in 1965. The basic principal was defined as “the animating principle of the whole process of education regarded as continuing throughout an individuals’ life from his earliest childhood to the end of his days and therefore, calling for integrated organization. The necessary integration should be achieved both vertically throughout the duration of life and horizontally to cover all the various aspects of the life of individual and societies.” “Education is the development of all those capacities in the individual which will enable him to control his environment and to fulfill his possibilities.” - Jhondewey

Education is mainly concerned with the ways and means of teaching and learning. Even of these two, the latter appears to be more vital as it is not only concerned with what the teacher does but also with what knowledge s/he transmits to the students and what the students do to assimilate the knowledge. For a very long time, it was understood that more information transfer was teaching. Traditional education was
operated on the assumption that the time consuming steps of learning could be bypassed, that the final knowledge could be transmitted to the learner through a sort of intellectual feeling process. Thus, schools were considered knowledge shops and the process of education was only unidirectional. Subjects were taught according to the will of teacher and little attention was paid to the eagerness, curiosity and capability of the pupils.

The goal of our government to provide equal opportunity will remain as daydream unless problems associated with regular classroom are not overcome. It is a very difficult task for the teacher to take care of each and every student in a heterogeneous classroom comprised of many individual differences among the students. It is impossible for the teacher to teach every individual according to his/her pace of learning and level of understanding in a limited time period. In a traditional classroom it is not possible for a teacher –

- To provide teaching material according to the need of each student
- To teach every student according to his/her own pace of learning.
- To provide teaching material for more time according to the need of student.
- To access the learning of all individuals and keeping records of them.
- To guide the students keeping in view their individual differences

Thus education may be defined as a purposive, conscious or unconscious psychological, sociological, scientific and philosophical process which brings about the development of the individual to the fullest extent and also brings about the maximum development of society in such a way that both enjoy maximum happiness and prosperity. Therefore, our society has provided educational institutions like schools to impart desired service to all the individuals and significantly improve their developmental patterns from the childhood. Students learn and benefit from school which is indicated by their achievement and performance in academic and co-curricular activities. Schools are one of the starting points for education. School education is therefore regarded as the base on which one’s life structure depends.

The Education Commission (1964-66) began its report with these words. “The destiny of India is now being shaped in her classrooms. This we believe that it is not mere rhetoric. In a world based on science and technology, it is education that determines the level of prosperity, welfare and security of the people. On the quality and number of persons coming out of our schools and colleges will depend our
success in the great enterprise of national reconstruction, the principle objective of
which is to raise the standard of living of our people.” School education provides the
consciously created environment for the all-round development of the student. As far
as quality of school education is concerned, it should have much potential so that it
can provide the essential challenges to the students. It would help them to develop the
maximum abilities according to their needs. In the modern age, the role of school is
very important. A school is thus considered as a sub-system of the total social system.
The school is one of the most popular formal agencies of education. It plays an
important role in imparting knowledge and ideas, developing skills and interests,
modeling attitudes and inculcating values to children. It is a social organization for
catering to the need of society and for serving the ends of the people. The school
trains the citizens for tomorrow and prepares them for the future life. It should
provide all facilities and suitable environment for the development of their all-round
personalities. Dr. Zakir Husain (1959) has aptly remarked, “All our educational
institutions will be communities of work. In all these educational institutions, the
pupils will have facilities to experiment, to discover, to work, to live where work will
fashion character and living will shape lives and like healthy work and like all good
life they will form into homes of co-operating communities engaged in elevating co-
operation, initiative and accepting responsibility through an inner use for self-
discipline, self-realization and mutual helpfulness.”

The school should not be viewed as a place of imparting traditional
knowledge, but as a place where experiments in life are carried on and experiences
are gained for enabling children to live better, richer and effectively. The school
should be the reflection of the large society outside its four walls and the children will
learn by living. The school is the “epitome” of the life outside the homes and children
need to be given all kinds of experiences. In India our school education system is
divided into three stages: Elementary, Secondary and Higher Secondary Education.
Primary education system is also divided into two levels: Primary and Upper Primary
level. At Upper Primary level many subjects are taught as compulsory subjects such as:
languages, mathematics, social sciences, general science and computer etc.

In the school curriculum, each subject plays an important role. Science is a
subject which broadens the horizon of an individual and develops various skills and
provides opportunity for the professional growth of an individual. Science has
important place in modern time. Science has spread its effect on to every field of life. Human beings try to understand the changes around them and constantly receive a great number of impressions through their various senses such as hearing, sight, smell, taste and touch. Making an effective use of senses and using communicative ability one accumulates information about one’s surroundings, organizes this information and sets regularities in it and tries to find out why the regularities exist and finally transmits one’s findings to the next generation.

1.1.0 Science teaching:-

Teaching science to every student has become inevitable part of general education. It was included in school curriculum for acquiring knowledge and skills as the other subjects. But in addition to them science inculcates certain special values which no other subject can provide. Besides satisfying the usual needs as a subject in curriculum such as intellectual, cultural, moral, aesthetic and vocational values, science learning provides training in scientific method. It helps to develop a scientific attitude in the mind of the learner. Science is a cumulative and endless series of empirical observations which result in the formation of concepts and theories. Science with both concepts and theories is subjected to modification in the light of further empirical observation. The Science Manpower Project defines science as “science is cumulative and endless series of empirical observation, which result in the formulation of concepts and theories beings subject to modification in light of further empirical observation. Science is both a body of knowledge and process of acquiring and refining knowledge.” In Columbia Encyclopaedia science is defined as “science is accumulated and systematized learning in general usage restricted to natural phenomena. The progress of science is marked not only by an accumulation of facts, but by the emergence of scientific method and of the scientific attitudes.”

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-Henri Poincare

From these definitions, nature of science can be identified as follows:-

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1. It is accumulated and systematized body of knowledge.
2. The knowledge that is accumulated has been logically arranged applying scientific thinking process which is today known as scientific methods of inquiry.
3. Science is nothing but organized common sense.
5. Knowledge in science is replicable and dynamic.
6. Scientific knowledge is based on values of objectivity, rationality and neutrality.
7. Science makes predictions and describes various phenomena.
8. Science is universal, i.e. facts, concepts, generalizations, theories and laws have universal acceptance and applications.
9. For these reasons science subject has become so popular in our schools and it is being taught as a General Science, a compulsory subject.

To teach science as a core subject mainly in school education, the government of India after independence appointed a number of commissions to work out the syllabus, infrastructure, evaluation procedure, teaching aids, study material, qualified staff and other allied problems and recommend suggestions. A number of eminent educationists worked on these problems and their recommendations led to the development of science curriculum and established science as a core subject at various levels of education.

**University Education Commission** (1948-49) recommended the inclusion of General Science and Mathematics as a core subject at the middle as well as at the secondary level. **The Secondary Education Commission** (1952-53) considered General Science as a core subject in school curriculum. **Indian Education Commission** (1964-66) recommended that science and mathematics should be taught as compulsory subjects to all pupils as a part of general education during the first ten years of schooling. Emphasis should be given on the acquisition of knowledge, ability to think logically, to draw conclusion and to make decisions at upper primary level. **National Policy on Education** (1986) recommended that science and mathematics should remain as compulsory subjects in the first ten years of school education. It must be strengthened because all the areas of development are based on science and technology.
Compulsory teaching of science, as a part of general education up to class VII or VIII, had been in practice in most of the states and UTs before the introduction of a uniform pattern of school education in 1975. During this period the subject was usually taught as General Science in most of the states. The education commission chaired by Prof. D. S. Kothari has been an important landmark for its depth and expanse of vision of education in India. This led to the introduction of the 10+2+3 pattern of education in 1975. A National Curriculum Committee gave recommendations and guidelines for the new pattern through a policy document titled “The Curriculum for the Ten-year School- A Framework”. Some of the main recommendation contained in the ‘Framework’ that had a direct implication on the teaching of science, its syllabi and textbooks were:

1. “All subjects including science and mathematics were to be compulsory for all students up to class X, as a part of general education.

2. An integrated approach was to be followed for the teaching of science at the upper primary stage as opposed to disciplinary approach that was then in vogue, and science was to be considered as one composite subject at the upper primary and secondary stage.”

According to revised policy on Education (1992) “Science education will be strengthened so as to develop in the child well defined abilities and values such as the spirit of inquiry, creativity, objectivity, the courage to question, and an aesthetic sensibility. Science education program will be designed to enable the learner to acquire problem solving and decision making skills and to discover the relationship of science with health, agriculture, industry and other aspects of daily life. Every effort will be made to extend science education to the vast numbers who have remained outside the pale of formal education.”

According to NCF (2005) “Science teaching should engage the learner in acquiring methods and processes that will nurture their curiosity and creativity, particularly in relation to the environment. Science teaching should be placed in the wider context of children’s environment to equip them with the requisite knowledge and skills to enter the world of work.”

Teaching of ‘Science and Technology’ in place of ‘Science’ at the upper primary and secondary stages, familiarizes the learner with various dimension of
scientific and technological literacy. Thus, science curriculum in India has undergone several changes, both in approach and content, during the last forty years or so. At the upper primary stage, the disciplinary approach was replaced first by an integrated approach to science as a single subject, and finally by an approach integrating science and technology.

1.1.1 Nature of content in General Science at upper primary stage:

Science curriculum in school at upper primary level covers the following domains as cognitive, affective and psychomotor. All these three domains develop students’ higher order thinking skills. All the domains of science should not be learnt in fragmented manner but learned through integrated way. Enger and Yager (2001) stated that learning science promotes scientific literacy and it organizes around six domains. (i) The Concept Domain: it includes facts, laws, principles, theories, and internalised knowledge held by students fall under the umbrella of the concept domain (Yager and McCormack, 1989). (ii) The Process Domain: it includes the 13 processes identified by the AAAS (1968) in the development of science: A Process Approach is generally accepted sets of processes that scientists use as they accomplish their work. (iii) Application Domain: it is the extent to which students can transfer and effectively apply what they have seemingly learned into a new situation, especially one in their own daily lives (Gronlund, 1988). It is important because students use concepts and processes (iv) Attitude Domain: It includes development of positive attitude towards oneself and development of more positive attitude towards science in general. Gardner (1975) explained two distinguishable general categories of attitudes (i) attitude towards science (i.e., interest in science, attitude towards scientists, and attitudes towards responsibility in science) and (ii) Scientific attitude (i.e., open mindedness, honesty, or scepticism). (v) Creativity Domain: Creativity is integral to science and scientific process. Creativity promotes divergent thinking, alternative viewpoints, novelty, solving problems and puzzles. Creativity plays an important role in many of the processes of science and in doing science (vi) Nature of Science Domain: The nature of science is about how the ideas are generated and how these ideas are developed through particular ways of observation, experimentation, and inferences. The nature of science also talks about the way of knowing science. The outline of six domains of science is given by M. Ramesh (2014) shown in the Figure_1.1.
Figure 1.1: Domains of Science

<table>
<thead>
<tr>
<th>The Six Domains of Science</th>
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<tbody>
<tr>
<td><strong>6. Nature of science</strong> (what is science, who does it, why it is done)</td>
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<tr>
<td><strong>5. Creativity</strong> (thought patterns representing divergence and synergy)</td>
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<tr>
<td><strong>4. Attitudes</strong> (Perception of science, scientist, science teacher and scientific knowledge)</td>
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<tr>
<td><strong>3. Application</strong> (Ability to apply scientific knowledge)</td>
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<tr>
<td><strong>2. Processes</strong> (Scientific skill and method)</td>
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<tr>
<td><strong>1. Concepts</strong> (content, accumulated scientific)</td>
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<tr>
<td><strong>Knowing &amp; understanding</strong></td>
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<tr>
<td><strong>Exploring &amp; discovering</strong></td>
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<td><strong>Using &amp; Applying</strong></td>
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<tr>
<td><strong>Creating context &amp; big picture</strong></td>
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<td><strong>Feeling &amp; valuing</strong></td>
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The clarification and understanding of nature and structural arrangement of scientific knowledge can become a framework to provide guidance in the planning, evaluation and consequent restructuring of the content. Content of General Science is an ordered knowledge of natural phenomena and relation between the concepts and conceptual schemes. It has been developed as a result of experimentation and observation and thus explains the objects and events within our natural environment. Thus within the structure of content of General Science, these are arranged in **hierarchical arrangement**.

Thus science is an accumulated systematized body of knowledge which includes facts, formula, figures and diagrams, concepts, principles and information. It is stated in nature of science that the dual nature of science is process and product. Process and product are one of the important aspects of nature of science. Process leads to the development of products, and products can be verified through process. Science teaching needs to address the processes and products of science. All these form the **Product of Science**. Products are the outcomes of processes. Systematic observations and experimentation leads to the formulation of theories and
generalizations. Empiricism generally encompasses systematic study of facts, theories and generalization. The science process skills such as observation, classification, communication, measurement, prediction and inference and so on can be translated into immediate behaviour by the child as s/he attempts to understand the phenomena of science encountered in her/his environment. Pritamsingh (1971) says that pupils should observe measure, classify, use numbers, see relationship, make hypothesis, devise experiments, interpret evidence, draw conclusions and verify findings. It refers to the systematic way of knowing science. Science is not only a product but also a process by which this product of science is obtained. Science as a process involves classification, experimentation and measurement. Science is both thought and action. Thought is nothing but idea, conception, and a belief about the natural phenomena where in the action is methods and procedures or processes followed by scientists or students. The process includes certain set of skills and abilities such as observation, measurement, communication, testing hypothesis, design experiment, changing variable etc. Menon (1986) stated that the processes of scientific inquiry represent the spirit of science as an activity and its essence that it distinguishes science from other discipline. Hands-on minds-on experiments and activities provide rich learning experiences for the students to acquire science process skills. These are chiefly mental skills, but also associated with physical skills.

1.1.2 Objectives of science teaching at upper primary level:-

The students of upper primary class are first exposed to study science as a separate subject. This is the stage where in students can construct basic scientific concepts, acquire skills and develop attitudes. According to Piget, upper primary level students are in the formal operation stage (age of 11 to 14). At the formal operation stage children show interest to operate scientific equipments and experience the process of science. Therefore, the objectives of teaching science should fulfill the needs and interests of the learner. The objectives of education have been changing from time along to time with the philosophy of life and needs of the country. The Indian concept of education differs from the western concept.

The aim of science teaching at different stages has been summarized according to different commissions. All India Seminar of the Teaching of Science in Secondary Schools published by Ministry of Education in 1956 has given some objectives of science teaching at the Upper Primary level as follows:
“Acquisition of a kind of information concerning nature and science which may also serve as the basis for a later General Science course.

To develop the ability to reach generalizations and to apply them for solving everyday problems.

To understand the impact of science in our life.

To inspire children by stories about scientists and their discoveries.

Developing interest in scientific hobbies.”

The Education Commission (1964-1966) has suggested the aims of teaching science at Upper Primary stage:

“To develop among children proper understanding of main facts, concepts, principles and processes in the physical and biological environment.

To develop the ability to think logically, to draw conclusions and to make decisions along with the acquisition of knowledge.”

Ishwarbhai Patel committee (1997)

“Acquisition of tools of formal learning, namely, literacy, numeracy and manual skill.

Acquisition of knowledge through observation, study and experimentation in the areas of social and natural science.

Acquisition of skills of purposeful observation.

Development of aesthetic perception and creativity through participation in artistic activities and observation in nature.”

In the report of National Seminar on Teaching of Science, organised by EKLAVYA, Bhopal in Nov 1985, goal of science teachers were set as follows:

“To develop an interest in children in physical processes in their immediate environment.

To train them to gather available information on a particular phenomena.

To analyse the available data so as to reach logically consistent and empirically valid conclusion.”

On the basis of National Curriculum Framework for School Education (2000) the objectives of science teaching are to:

“Expose the children to basic processes of science.

Develop the understanding of some basic principle and laws of science.

Make children understand applications of basic scientific principles to solve problems related to daily life.
Develop the ability to apply appropriate concepts of science.

Develop measurement skills and to encourage use of locally available resources.

Familiarize the children with life processes, health, nutrition and human disease.

Create awareness of the immediate environment and a need for its protection.

Make children recognize the relationship of science, technology and society.”

National Council of Educational Research and Training (NCERT) 2001 has suggested the following objectives for Upper Primary stage:

“To expose children to basic processes of science;
To understand the processes that underlie simple scientific and technological activities;
To develop some understanding of the basic principles and laws of science and their application to solve problems related to daily life;
To familiarize the children with life processes, health, nutrition and human diseases;
To inculcate in children some of the science and technology related values;
To provide scientific and technological literacy to the learners.”

There are also some general objectives of science teaching which are related to over all development of students according to the needs of the society. These objectives also develop the scientific attitude and logical thinking in students. These objectives are as follows:-

To apply the knowledge of science in everyday life.
To develop the ability to investigate new knowledge in the field of science.
To develop scientific attitude in children.
To develop the capacity how to understand scientific facts on his own.
To develop the ability to solve problems around oneself.
To make the child creative.
To train the child in science processes.
To develop their curiosity to learn science.
To train students in scientific method of learning.
To impart a basic background of nature of scientific culture.
To develop interest of students in science.
To prepare students for science related vocations.
➢ To make students aware of social implications of various discoveries of science.
➢ To enable students to appreciate the role of science in their daily life.
➢ To inculcate scientific tamper among students.

These objectives cannot be realized unless there is proper teaching by the teachers and proper understanding by the students about concepts.

The objectives of science teaching can only be achieved if the teaching is effective and is based on the principles of teaching. How will the students learn effectively? It will depend on the methods the teacher adopts. A science teacher should use proper method of teaching to make the learning relevant and useful. There are various kinds of teaching methods and techniques from which a science teacher can select the most relevant one, keeping in view the needs of the learner and its relevance to the science content. The selection of a suitable teaching method is based on the objectives of the content, needs of the learners and the nature of the content. There are many methods of teaching but science teacher selects a particular method based on the needs of the content, teaching facilities available, ability of the students and the philosophy of the teacher. The word ‘method’ in Latin means ‘mode’ or ‘ways’. In education it means the mode by which the material is communicated from the teacher to the pupil. Methods of teaching may be defined as the methods by which the teachers impart knowledge and skills while teaching and the pupils comprehend knowledge and acquire the skills in the process of learning. This definition clarifies that method includes both teaching and learning.

Gage (2003) has defined teaching methods as: “Teaching methods are patterns of teacher behaviour that are recurrent, applicable towards subject matter, characteristic of more than one teacher, and relevant to learning.” It means methods are a part of the behaviour of the teacher which one uses as a strategy or tactics of teaching. The method is also related to content and is helpful in generating learning. Later on, methods of teaching were influenced by the educational psychology where the work of Thorndike and Skinner tried to combine teaching and testing, along with environmental objective and giving instruction in sequential steps. This was also related to the performance of the learner which can be observed and measured. It will be relevant to say that the teaching methods have been influenced, over the years, by the factors, such as: Educational goals, Cultural and political, Study of learner’s
intellectual growth, Educational psychology, Analysis of learning and teaching and Technology. Thus, teaching methods are not random collection of techniques.

There are two major approaches of teaching and learning of science, based on the role and position of teacher and students in teaching-learning process.

1.2 Figure: Student Centered Approach and Teacher Centered Approach

Source: NYCizone; A.T. Kearney analysis

The objectives of science teaching can only be achieved if the teaching is effective and is based on the principles of teaching. How will the students learn effectively? It will depend on the method the teacher adopts. Method of teaching is just a way of teaching. Method is the style of presentation of contents in classrooms. There are two major approaches of teaching and learning of science, based on the role and position of teacher and students in teaching-learning process.

1. **Teacher Centered Approach:** - Teacher Centered Approach is one of the most popular approaches of teaching in our schools. This is a teacher structured approach and the students are just passive listeners most of the time. Very few teachers allow questions during the lecture, though some of them give sometime to their students to ask questions after the lecture. It is also known as expository, behaviourists or instructive approach. In this approach, the focus is on telling, memorizing and recalling information. The teacher plays an active role and instructs the student to learn various concept of subject he or she is teaching. Pupils are passive listeners and recipients of knowledge. The teaching-learning environment is completely formal; the
teacher occupies the central position and plays an autocratic role in the classroom. E.g. lecture method, lecture-cum-demonstration method, team teaching etc. In Teacher Centered Approach time place and pace of learning and generic teacher role are not aligned to teacher student and students’ needs. Teacher Centered Approach is quick and a lot of knowledge can be imparted in quite a lesser time. It is a convenient and easy and a teacher is free to develop his/her own style of teaching according to students’ individual differences. In Teacher Centered Approach students’ previous knowledge or entry behaviours are usually not taken into consideration. In this approach the teacher is more involved than the child, and therefore Teacher Centered Approach should be used to teach skills to the child.

2. Student Centered Approach: - In this approach, the whole process of teaching-learning revolves around the needs, requirements, capabilities and interests of pupils. Here, the teacher plays a passive role. The pupils play an active role as they construct knowledge on their own or jointly with the teacher. The teacher’s role is to create conducive environment of learning, provide and create resources, develop problems, guide, facilitate and motivate students in the process of learning e.g. problem-solving method, discovery method, project method, laboratory method, assignment method and programmed instruction. In student-centered approach globally competitive standards are focused on students’ personalized learning. In teaching science by lecture method or by lecture-demonstration Method, innovative teachers involve their children in interaction and question-answer sessions that even their lecture and lecture-demonstration becomes child centered. In Student Centered Approach, cognitive, effective and psychomotor domains of students enhance during learning capacities. Students improve their different skills such as problem solving skills, motivation level for learning, time management, communication skills and learning capacities. Though teaching is an art and teachers are trained through teacher education program. It is important to note that a method should not become an end in itself but should be used as a means to achieve the set aims of teaching. Some methods should not be strictly followed at all times but should be made flexible to suit the infinite variety of circumstances and conditions existing in a given situation. The teacher is free to use a variety of the methods according to one’s own abilities, interest and
experience, and also of the students working under particular circumstances. The method of teaching ensures the use and development of the sense of touch, sight and hearing.

The basic idea of the teaching method is that the students should discover everything they learn about from their own observations and experiments. Instead of imparting facts the teacher should provide activities in which the students work independently and by this means get training in scientific method.

The teaching learning process is based on some psychological principles. The teacher and student together participate in this process. The teacher is a facilitator of learning and creates conditions to suit the need and requirements of learners. The present study focuses on upper primary level students because they are not involved in doing activities or in first-hand observations and hence their concepts are not clear. They may memories and recall without understanding. When the concepts are not clear in lower classes, their cumulative effect is seen in higher classes; other than this there are new concepts at secondary levels which can be clarified through activities or relevant demonstrations. Thus the Student Centered Approaches facilitate development of inquiry processes, maximum autonomy and critical thinking. The student- centered learning mainly focuses on student, in particular, on the cognitive development of the student. In this method students play active role and learn through ‘learning by doing’ activity. In modern time lots of teaching aids are available for the better learning of students.

Emphasis should be made more on learning than teaching. Laying stress on the process of learning particularly, self-learning the UNESCO report “Learning To Be” has suggested that the modern methods of teaching should help individuals to learn better and independently not only inside the school, but also outside the school. Modern media of communication are to be utilized for the purpose and educational technology can be used for effective as well as efficient learning. Now–a–days schools are becoming learning resources center where children discover knowledge and explore new avenues of education. Days are gone when pupils were required to cram information doled out of them. Today, children are to be lead to enjoy curiosity, creativity and discovery. Now mastery of the subject matter is not as important as the methods are modalities of learning process. The teaching- learning situation should
provide experience of problem solving skill and the pupils can proceed at their own pace of learning through self-learning methods.

To keep in view that this is the period of knowledge explosion, there is a need to develop interest, curiosity, scientific attitude, analytical ability and self study habits. It is a fact that these abilities are not developed through the use of traditional methods. So, there is a need to use more than one technique in the instructional process. In the most of the Indian classrooms, science teaching is based on lecture method which is supported by occasional demonstration. In this age of technology, it is also possible to use television, computer or other self-learning mechanical devices.

Effective science teaching needs participation of pupils in a meaningful activity. A science teacher has to develop inquiry behaviour to lead a discussion and the teacher will not be satisfied by just giving information.

Learning takes place most rapidly if the learner is actively engaged with the subject matter. This is possible if a learner is properly motivated and one’s motivation is reflected in paying attention. Learning takes place in individuals, the learning situation should be designed in such a fashion that each student can learn as per one’s learning speed or ability. In other words, each person should learn at one’s own rate or pace. In other words, a learner moves according to one’s own learning capacity. The learning capacity varies from one student to another.

1.1.3 Inclusion of technology with science education:-

The use of computers in schools has been recognized to improve learning as well as enriching the process of education. The National Policy on Education 1986 has laid emphasis on the use of computers in learning. In the present age of science and technology computers and computer – based technology are being used in every walk of life and even in classroom teaching. In classroom teaching, the instructions are imparted through computers. But even today the educationist, teachers and researchers are not sure whether computer based teaching approach is more effective than the traditional classroom teaching or the traditional class room teaching methods are more effective than computer based teaching approaches.
The greatest contribution of Information technology is the development of computer and its use in all sectors of life. They have become more powerful (i.e., able to process and store much more data), faster, cheaper, portable, easy to use and more convenient. Personal computers (PCs) and laptops are now within the reach of even ordinary people. In recent years, accessories such as- hard disk, CD-ROMs, printers used with computers had also developed rapidly. Using these, a computer program can handle sound, picture and video along with the text. “Multimedia” is a buzzword today in the field of computer. Multimedia involves combining text, sounds, still pictures and video etc. The concept of multimedia came into existence in early 1990s.

Multimedia also refers to computer media. Multimedia is the integration of multiple forms of media. This includes text, graphics, audio, video and many more. For example, a presentation involving audio and video clips would be considered a ‘multimedia presentation.’ Educational software that involves animations, sound, and text is called ‘multimedia software.’ As the information is presented in various formats, multimedia enhances user experience and makes it easier and faster to grasp.

The old days of an educational institution having an isolated audio-visual department are long gone. The growth in use of multimedia within the education sector has accelerated in recent years, and looks set for continued expansion in the future. Mehar, Ram et. al. also found positive effect of Computer Assisted Instruction on achievement of students.

This means that the world of computers is getting easier to the world of human beings. As the hardware develops, computer displays become more realistic and cheaper. The computer with its virtually instantaneous response to the student input, its extensive capacity to store and manipulate information, its unmatched ability to serve many individual students simultaneously is widely used in instruction. The computer has the ability to control and manage a wide variety of media and learning material – films, filmstrips, videos, slides, audiotapes and printed information.

Computer plays an important role in different fields of Education. Nowadays, government provides good Infrastructural facilities like Smart Board, Computers, LCD Projector under the scheme of Information and Communication Technology in Schools (ICT in Schools) during the XI Five year Plan between 2007-2012 to promote ICT based learning (MHRD, 2010, b) and with the effort of teachers, teaching learning process becomes effective and interesting. Use of Computer in the schools is
more than expensive and entertaining toys; they evidenced that educational microcomputer use truly enhances learning in democratic way (Ranade, 2001).

According to UNESCO (2005) information and communication technology is a scientific, technological and engineering discipline and it is used in handling information related to teaching-learning processes. Its application is in association with social, economic, cultural and educational matters. At the Government level, computerization in India was promoted through its National policy on Education, 1986. The policy laid emphasis on the role of computers in enhancing the efficiency of the learning process, in making children more creative and in providing them with an individualized learning environment.

Computer plays tremendous role in teaching – learning process. It provides a dynamic interaction between computer and students. Computer used as a delivery tool presents information, receives the response, analyzes the response and gives immediate feedback to the students. As a result of the rapid development of the information and communication technology, the use of computers in education has become inevitable. The use of technology in education provides the students more suitable environment to learn, serves to create interest and a learner centered-atmosphere, and helps increase their motivation. In parallel with the technological advances; technological devices, particularly computers began to be used in educational environments to develop audio visual materials such as animation and simulation, which resulted in the development of the computer-based instruction techniques.

The best example of the integration of science and technology is the Computer-Based Instruction technique. The use of computers in the teaching and learning activities is defined as Computer-Based Instruction (CBI). CBI is the use of computers in the teaching and learning activities (Brophy, 1999). CBI enables the students to learn by self-evaluating and reflecting on their learning process. CBI motivates children to learn better by providing immediate feedback and reinforcement and by creating an exciting and interesting game-like atmosphere. The studies in the field reveal that the students’ achievements increase when the CBI technique is provided as a supplement to the classroom education. CBI is more effective on less successful children. Thus the computer-based instruction enables the children to progress at their own pace and provides them with appropriate alternative ways of learning by individualizing the learning process (Senemoğlu, 2003). The most familiar
function of the science education is to teach the children the science concepts in a meaningful way and enable them to lean how they can make use of these concepts in their daily lives (Çepni, Taş, & Köse, 2006).

The computer based teaching had an impact on the development of the educational technology to a great extent in the 21st Century and this has resulted in the production of the software for the computer-based instruction. The primary purpose of the educational software is to solve the learning problems in the science courses encountered by the primary school students, to increase their motivation and achievements and to protect them against the negative effects of the rote-memory based educational system.

The computer-based instruction makes teaching techniques far more effective than those of the traditional teaching methods as it is used for presenting information, testing and evaluation and providing feedback. It makes a contribution to the individualization of education. It motivates students and gets them to take an active part in the learning process. It helps to develop creativity and problem solving skills, identity and self-reliance in the learners. CBI provides drawings, graphics, animation, music and plenty of material for the students to proceed at their own pace and in line with their individual differences. It serves to control lots of variables having an impact on learning, which cannot be controlled by means of traditional educational techniques (Kaşlı, 2000; Chang, 2002).

Computers are the basic techniques used in Teaching-Learning process to improve the learning level of students. There are some basic factors, which affect the learning of students during computer based learning. These are learning about computers, learning with computers and learning through computers.

1. Learning about computers involves the knowledge of computers at various levels such as knowing the uses of the computer and the names of the various parts, knowing how to use the keyboard and computer packages and so on (Owusu et al., 2010). According to Tabassum (2004), the knowledge of computers may be thought of as a continuum which ranges from skills in and awareness of computers at lower level to programming at higher level.

2. Learning with computers, students use computers as a tool in data acquisition, analysis, communication with other people, information retrieval and myriad other ways (Owusu et al., 2010). Learners use computers to get information and do their homework.
3. The term ‘learning through computers’ involves the use of computer as an aid for the teacher to do their presentations, and to get the learners to practice and drill. Computers are used to enhance interactive activities, to provide immediate feedback, to facilitate the retention and to enable the learners at diverse levels to work at own their pace.

This study focuses on the learning through computer. The theoretical basis of the study derives from the operant conditioning by Skinner as described by Owusu et al. (2010) in their study. “Operant conditioning is a type conditioning in which a learner achieves some outcome by producing an action which is called the operant. If the operant is followed by something pleasant, the outcome is positively reinforced but if it is followed by the removal of something unpleasant, the outcome is negatively reinforced.” The theory that was influential during the heyday of the Audio-Lingual method which lost favour in 1960s was revived after the introduction of computers into education. Skinner’s reinforcement theory is central to computerized learning; especially drill and practice and tutorial learning (Tabassum, 2004). In these computer facilitated learning, students’ behaviours are reinforced by being permitted to proceed to the next frame when they get the right answer (Bigge&Shermis, 2004). Tabassum (2004) indicates that Skinner illustrated how to develop programmed learning sequence which is being used directly to design tutorial modules. According to Owusu et al. (2010), “the use of computer-assisted instruction especially in tutorials mode is supported mostly by the behaviourist view of learning. This is due to the principle of practice and reinforcement. Therefore, the developers of tutorials mostly incorporate this theory of learning in their programme”. The study makes use of the operant conditioning deriving from the practices of Skinner’s behaviourism. The materials and activities are presented in graded steps. Learners have the opportunity to be active in the learning process and receive immediate feedback and work at their own pace.

In this way, instructional process is multi-dimensional in nature. According to Education Commission (1964-66), in this world based on science and technology; it is education that determines the level of prosperity, welfare and security of the people. Our success in the great enterprise of national reconstruction depends upon the quality of education and persons passing out of our schools and colleges, so it is necessary to renovate the educational system. It should be reconstructed according to the needs of the present society. Changes in Science and Technology have had considerable impact
on the educational system which aims at developing the ability of people to keep pace with each other in order to effectively apply technology to raise the level of efficiency. Therefore, the educational system must be changed. It will not be restricted in any ways; on the other hand, new features using computer aided instruction, interactive multimedia technology for educational purposes can prove their role, function and utility to suit the needs of the 21st Century. Different researches have been conducted in the field of computer education abroad as well as in India. As far as India is concerned, very little work has been done in the field of computer; work regarding to the computer in education is still in experimental stage.

Smart class is a comprehensive solution designed to assist teachers in private schools in meeting day to day classroom challenges and enhancing students’ academic performance with simple, practical and meaningful use of technology. It also enables teachers to instantly assess and evaluate the learning achieved by their students in class. Smart class is powered by a vast repository of digital instructional materials exactly mapped to meet with the specific objectives laid out by different state learning standards. The content repository consists of thousands of highly animated, lesson specific, 2D and 3D multimedia modules built with an instructor-led design that allows the teacher to effectively transact the lesson in a typical classroom of diverse set of learners. Educational videos from Discovery channel, NCERT and government are available for teachers to use in the classroom. The modules are embedded in a template that allow the teachers to teach a chosen lesson in class, frame by frame, with engaging and instructionally sound animated set of visuals while retaining complete control on the pace of delivery.

The Smart Class Multimedia System helps in establishing an easy yet effective control and communications system for teachers in the computer lab and ensures that teachers have uninterrupted quality time with students while dealing with learning concepts. This solution will enrich teaching methods with modern technology and introduce the children to a wealth of information and interactive learning techniques to improve the overall education experience.

At the upper primary stage the child should be engaged in learning principles of science through familiar experiences, working with hands to design simple technological units and modules (e.g. designing and making a working model of a windmill to lift weights) and continuing to learn more on environment and health through activities and surveys. Scientific concepts are to be arrived at mainly from
activities and experiments. Science content at this stage is not to be regarded as a diluted version of secondary school science. Group activity, discussions with peers and teachers, surveys, organization of data and their display through exhibitions, etc. in schools and neighbourhood are to be an important component of pedagogy. There should be continuous as well as periodic assessment (unit tests, term end tests). The system of ‘direct’ grades should be adopted. There should be no detention. Every child who attends eight years of school should be eligible to enter Class IX.

At the upper primary stage the children get their first exposure to ‘science’; this is the time to bring home the right perspective of what it means to ‘do science’. Science education at this stage should provide a gradual transition from environmental studies of the primary stage to elements of science and technology.

One of the newest teaching aids and devices currently being developed and used in innovative programmes is the self-instructional, student paced, Learning Activity Package (LAP). Packaged instruction is based upon the premise that the learner is an individual with unique needs, desires and experiences. A Learning Activity Package (LAP) is a body of knowledge which focuses on one skill, attitude, idea or concept. LAPs are: - (1) self-instructional (2) student paced (3) student directed and (4) they provide for accountability of learning. (Proctor. K.)

Learning Activity Packages are the packages of resources materials including tapes, slides and printed materials designed to meet the need of a student in a particular instructional sequence.

Through Learning Activity Package students are active rather than passive. Learning Activity Package provides students with oppournities to develop their self esteem and an increase in the level of achievement in the content area. These techniques allow students to work through the material in a systematic, efficient and timely manner.

According to George and Alexander “A self-directed Learning Activity Packet is a method of communication between a student or small groups of students and instructor. The content of a particular topic or activity is explained through the use of self-directed learning activity packets. With this method the teacher sheds the role of

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2 K. Proctor “designing a learning activity package” red river college. Pg.no. 3-5.
presenter, demonstrator, driller and questioner and now takes on the role of facilitator, initiator, monitor, coach and co-coordinator.\textsuperscript{3}

In designing Learning Activity Package many components needs to be addressed; for e.g., will the learner have adequate time to achieve the task at an acceptable level? Do the students have the knowledge and understanding necessary to complete the task? Can students formulate questions to ask when conceptual information is needed? Do students have the necessary motor skills that may be required? Are the students mature enough to be self-motivated learners? Thus the learning activity package provides information to students on specific topics. The package contains introduction, objectives, explanations, allotted time, related readings, pre and post measures and a list of required supplies (George and Alexander 1993)\textsuperscript{4}. Thus the Learning Activity Package becomes the source of motivating the students.

1.2. Rationale of the study:-

Science is now one of the compulsory subjects in Upper Primary level. The teacher should provide such situation in which students feel the need of asking some questions. The teacher should have democratic attitude and join the students in exploring problems, find out the solutions and proposing ways of testing data. Students have questions and problems and the teacher should listen to their problems, teacher should help the students to find ways to answer their problems. They should suggest such activities and provide situations in which the students can find out the solution of the problems. Thus setting up the problem may be a co-operative approach for the teacher and the students. The teacher opens up a field for investigation and asks the students to suggest places where problems might exist. It is important that the teacher should accept such problems suggested by the students which ones feels that it is up to the needs, capabilities and intelligence of students.

“Learning by doing” is one of the cardinal principles of teaching science. The achievement of modern science is mainly due to the application of the experimental method. Apart from the logical necessity of student centered method in science, it has the following values:-


The things learnt by the students through purposeful activity are permanently affixed in mind of students. They find out the truth of the statements made by teachers or written in the books when they perform experiments.

The children have the curiosity to know the new knowledge which is related to their daily life, environment and this new knowledge is learnt by students through different activities.

Acquiring of scientific knowledge and scientific outlook are the two main objectives of teaching science, and it can be achieved only through regular activities. A student should not be passive observer but an active worker, an enthusiastic experimenter and a discoverer.

It provides opportunities for training in scientific method. The students face so many problems in different activities and they get a good deal of training in solving the problems in the scientific way.

As a result of learning by doing or self-learning the students learn many good habits like co-operation, resourcefulness, initiative, self-dependence and self-reliance. These are applicable in the daily life of students.

Computers based LAP provides a way for students to engage in project-based learning. Laptop computers and wireless network connections allow the teachers to incorporate multiple computers into the classroom, to take them on field trips and send it home with students. It helps need to complete electronic or research assignments. Computers help students access timelines, historical data, images, graphs, scientific findings, art, pop culture, current events and music that make projects come to life. Classroom computers also allow students to share files, work on group assignments and distribute knowledge quickly and efficiently. Classroom computers based LAP make it easier for teachers to delegate their time and attention. Programs geared toward remedial students, advanced-learning software and tutoring help teachers address the needs of students who are fall behind or require more challenging workloads. Since a teacher usually teaches through the median-level student. In the classroom, computers help in the learning process. As long as a teacher doesn't become dependent on classroom computers causing one to slack off on lesson plan preparation or lose ones creative edge, computers provide a more comprehensive learning experience. Assignment logs are easily made on computers. They can also use computers during break times to brainstorm classroom activities, research age-
appropriate projects and locate multimedia presentations to complement academic subject matter.

In school the students often use software programs and LAP resources. These develop the basic skills, such as reading comprehension, grammar, math, spelling and punctuation. Headphones make it possible for individuals or an entire class to participate in interactive learning, allowing each student to work at her own pace. Some basic skills require practice and repetition. So computerized games make learning more interesting for the students.

In teaching learning process, computer based Learning Activity Package is helpful in the fulfillment of students’ learning objectives. LAP is an essential tool for teachers and students. On the basis of these ideas, some questions arise in the researcher’s mind. Such as: is LAP sufficient learning package for individual learners according to their individual differences?

Does the Learning Activity package fulfilling students’ curiosity, problem solving ability, scientific attitude, learning capacity, self-evaluation level and synthesis and analysis qualities?

Does the Learning Activity Package enhance the level of reading performance, cognitive styles, self-confidence, computing skills, learner content interaction, learner-learner interaction, self-regulated learning and self-efficacy?

Is the Learning Activity package appropriate for Upper primary level students and is it more effective the than traditional teaching methods?

Does the Learning Activity Package give positive impact on academic achievement, learning performance, motivation level for learning, psychomotor activities and content understanding? To find out the solution of these questions, this problem is selected by researcher.

1.3 Title of research: Development of ‘LAP’ and Its Effectiveness in Science Learning at Upper Primary Level.

This chapter discusses the conceptual framework and the rationale along with the problem. The next chapter discusses review of related literature and consolidation of related literature which has provided a base for the conceptual framework of the study.