INTRODUCTION
"Men love to wonder", said Ralph Waldo Emerson, "and that is the seed of science". This seed of science blossoms to find best means to secure a more abundant life for each world citizen. Science has specific application in various activities of our life. The clothing we wear, the houses we live in, the food we eat, the automobiles we travel in, the telephones, the telex and the fax we communicate with and other electronic and electrical gadgets we use in our homes—all are based upon scientific information. Our environment, which to a great degree is influenced by science, would be almost entirely changed if it were not continually exposed to the application of scientific principles.

Today it is essential that science and technology is used to deal with key issues of nation building—related to removal of poverty, control of population explosion, building of an internationally competitive economy and day by day increasing ecological imbalances. India's first prime-minister Jawahar Lal Nehru dreamed of bringing the people of India out of their age-old status of basic subsistence to the new era of security and prosperity. He stressed that this could only be achieved through science
and its applications. He had once observed, "In the world today, science is advancing so fast that it is changing the very texture of men's lives. If we cannot bring ourselves to appreciate these changes, if we want to live in a grove of thought and action, if our social organisation is in traditional form which does not change with the changing time, then we are doomed as a nation and as a people. It was because we forgot all this some hundreds of years ago that we became a subject people. And if we still want to carry on in the old traditional groves, then we shall fail again in spite of our independence."

It is no wonder that when India became independent in 1947, it decided under Jawahar Lal Nehru's visionary leadership, to go all out to pursue education and research in all disciplines, with a major stress on science and technology. Nehru realised that science and technology comprised the twin paths to India's rapid progress. A great deal of resources went into the effort and the scientific community responded with results that would do any country proud.

A cursory glance at our achievements since independence reveals that our life span has increased from 23 to 57 and even with double the population the green revolution has made the nation more than self-sufficient in food grains; India's heavy industry has grown to occupy
tenth place in the world; India has designed, fabricated, erected and operated nuclear power plants and has conducted a safe underground nuclear test; it has established two permanent stations at Antarctica, and the third one is on its way to completion; India is farming mineral modules from the sea bed; Indian designed telecommunication and remote sensing satellites are circling the earth; India has successfully tested surface-to-surface and surface-to-air missile systems; and it has the third largest reservoir of trained manpower in the world. It can be observed that due to the efforts of our scientists, science has made inroads into the realms of health, transportation, power, communication, industrial processes and agricultural practices. Hence one can very well understand the significance of science for our existence. Science has become the very life breath without which it would be well nigh impossible to survive.

1.1.0 Progress of science education: A historical perspective

The world is progressing in scientific areas at such an astronomical speed that new and still newer secrets of nature are being unravelled. To keep pace with these developments in scientific areas, every person must be in close contact with the latest information about the fast
emerging concepts. A school can be the best medium to spread the scientific knowledge. Science is perhaps unique as a subject in the curriculum of schools all over the world. This uniqueness results from the variety of materials and experiments necessary for its effective teaching. It will be quite appropriate, at this stage, to look into the place of science in educational scene. Because of its multifarious values—intellectual, utilitarian, vocational, cultural, moral and aesthetic—to the individual as well as to the society, science has become a very important subject right from the elementary stage. John K. W. (1973) emphasised that science should be recognised and taught as a major human activity which not only explores the realms of human experience, but also maps it methodically and imaginatively by disciplined speculation and creating a coherent system of knowledge.

Kothari commission (1964-66) laid great emphasis on introduction of science in education. The commission remarked, "There is, of course, one thing about which we feel no doubt or hesitation: education, science-based and in coherence with Indian culture and values, can alone provide the foundation as also the instrument for the nation's progress, security and welfare. Science education should become an integral part of school education and ultimately become a part of all courses at University stage". Science
has to perform three fold functions: (i) as an integral part of general education, (ii) as a preparatory course for college science and (iii) as preparation for vocation (Nair, 1986). If we look into the past, we note that science was always given its due place in Indian education. We had great scientists and mathematicians like Nagarjuna, Aryabhatta, and Varahmihira. Rig-Veda, which is considered to be oldest Indian scriptures, contain detailed mention of the healing powers of medicinal herbs. The Vais'eshika presented the concept of atom. The Aryans increased their knowledge about the precious metals like iron and silver during Yajur-veda period. The Arthshastra written by Kautilya (321-300 B.C.) mentions the process of oxidising and melting different minerals. At the end of iron age the use of medicine, science and technology came to be accepted as an important part in the life style of the people. Takshashila emerged as the pioneer educational institution during the late iron period. Atraiya taught medicine there in the 6th century. Later on many of his disciples like Jeevak, Kumar Bhatt, Bhela and Parashar etc. contributed to the development of medicine. The people had the knowledge about fermentation and the process for the preparation and use of dyes. Charakasamhita which is supposed to be written in 600 B.C. suggests the use of purgatives in the treatment of fever, toxicity, leprosy, jaundice, cholera, piles, diabetes, and cataract. Aristotle (400 B.C.), a great
philosopher, contributed much to the development of science particularly the biological science. Pythagorus (582-500 B.C.) and Hippocrates (450 B.C.) rendered important services in the field of geometry.

During Mauryan period the science of metallurgy and civil engineering made significant progress. In Gupta period, Aryabhata and Varahmihira studied astromomy and revealed various secrets of the universe. During medieval period, India had contacts with Arabs and Europeans. Working out the calendar, dates of eclipses, casting horoscopes for astrological purposes and development of water clock were important achievements of that period. The archaeological excavations at Zawar in Rajasthan suggest that Indians knew the process of isolation of zinc by about the first century A.D.. With the arrival of Muslims, Indians started practising Greek (Unani) system of medicine which is still widely practised. On the whole, we find that the development of science in medieval India was rather slow. It could be partly due to the fact that at that time learning was restricted to a small elite group and partly due to absence of printing, which was introduced in India by the Portuguese.

From sixteenth century onwards, Europe became richer in scientific and material development as compared to India.
When British supremacy dominated the Indian subcontinent, the rulers wanted to garner all the knowledge of geography, geology and botany of the areas under their tutelage. They exploited India's resources to the full. The British colonisation demolished India's educational system. In the educational system introduced by the British, science was never given a high priority. Macaulay, who introduced English as a medium of instruction, was personally not interested in science and hence neglected it, making the curriculum purely literary. Science had to wait for some time to get an entry into the school curriculum. There were only a few medical colleges and engineering institutions and these too were merely supplier of assistants to foreign doctors and engineers. Then later on in 1875 Madras University decided to introduce in the matriculation examination the subjects of geography and elementary physics in place of British history. Degree in science was first of all granted by Bombay University. Although science education started then, but it was British culture oriented. When freedom movement gained momentum, people became more conscious about science. In Bombay, Jamshedji Tata favoured science education and research at higher level. Efforts in this direction led to the establishment of Indian Institute of Science at Bangalore in 1909. In the modern era our noted scientists like J.C. Bose, Acharya P.C. Ray, Noble Laureate C.V. Raman and S. Ramanujam have contributed much to the
development of scientific knowledge and innovations. In 1938 a National Planning Committee was framed under the chairmanship of Pt. Jawahar Lal Nehru. This committee dealt with various technical subjects, for example, education, industries, irrigation and public health. After independence, our government felt the need of emphasis on science education at school level for our own industrial and economic development. Mudaliar Commission (1952-53) or popularly called as Secondary Education Commission recommended that in high schools and higher secondary schools general science should be taught as a compulsory subject.

In 1956, an All India Seminar on Teaching of Science was held at Tara Devi at Shimla. It suggested a unique and uniform system for the whole nation that suited to its needs and resources. The seminar suggested solutions to various problems concerning syllabus, equipments, aims of teaching science at primary and secondary levels, and the examination pattern. As a result of its recommendations science education was given greater attention and importance. Schools were granted financial aid for the establishment of science laboratories, clubs, museums etc. Our politicians also were aware of the impact of science on human living. In August 1961, Indian Parliamentary and Scientific Committee headed by Sh. Lal Bahadur Shastri, studied the problems of
science at various levels of education. The relation between the policies and decision of the centre to state and courses offered in the schools were also examined.

Keeping in view the recommendations of Secondary Education Commission (1952-53) and Tara Devi Committee (1956) General Science was introduced as a compulsory subject in primary, middle and high schools. But later on the concept of general science was opposed by various commissions. The UNESCO Planning Mission, headed by Prof. S.G.Shepovalonko, stayed in India from December 23, 1963 to March 10, 1964. It studied position of science teaching in India. The mission boldly recommended the abolition of general science at the middle stage and suggested that physics and biology should be introduced from class VI and chemistry from class VII.

The Indian Education Commission (1964-66) also expressed its views against general science, "The general science approach to the teaching of science, which had been widely adopted at the elementary stage during the last ten years, has not proved successful as it tends to make science appear somewhat formless and without structure and runs counter to its methodology. A disciplinary approach to science learning would, it is felt, be more effective in providing the necessary scientific base to young people".
The Indian Education Commission favoured science as a compulsory subject and commented, "We lay great emphasis on making science an important element in school curriculum. We, therefore, recommend that science and mathematics should be taught on a compulsory basis to all pupils as a part of general education during the first ten years of schooling". Like Indian Education Commission, Unesco's International Education Commission (1972) also recommended - "Science and technology must become an essential component in any educational enterprise; they must be incorporated into all educational activities intended for children, young people, and adults, in order to help the individual to control social energies as well as natural and productive ones - thereby achieving mastery over himself, his choices and actions - and finally, they must help man to acquire a scientific turn of mind so that he becomes able to promote science without being enslaved by it".

Science education was also the main focus of the planners while making National Policy on Education (1986). The National Policy on Education (1986) states, "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 programmes 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”.

It is all due to our government and great educationists, that the situation now in this respect is quite different from past when science education was provided at few places only. We have now about 150 universities including 5 Indian Institutes of Technology, about 110 medical colleges, nearly 800 engineering colleges and various scientific research laboratories under the central and state governments. Science has become much popular among the masses and the students today chalk out their career right from the primary stage of their education. Now-a-days all the important branches of science such as physics, chemistry, biology, geology, medicine, agriculture, microbiology and anatomy etc. get their due place in school curriculum. The pupils choose the subject of their interest and calibre and fix their target to become a doctor, engineer, research scientists or agriculturists. Hence to keep pace with the explosion of knowledge in the realm of science, it is necessary to include every basic
concept and latest information related to scientific world in the school curriculum.

1.1.2 **Different modes of teaching science**

Having a glance at the Indian educational scene, one can locate thousands of schools and colleges mushrooming tremendously. After the attainment of freedom in 1947, education which was earlier accessible to only a few, became obtainable by the masses. It came to be perceived as the gateway to progress. Obviously then there was an enormous growth of institutions and a steep rise in enrolment figures at all levels of education. In the process of meeting the quantitative demand for education, qualitative aspect fell into oblivion. When this oversight resulted in the vast number of educated unemployed in the country, then the quality of education came under serious purview and scrutiny. Meaninglessness and futility of degree based education, without embibing the sense of dignity of labour in the pupils, came to be seriously questioned. In this direction National Council of Educational Research and Training, New Delhi (NCERT) and Educational Research Departments of the colleges and universities undertook research studies to find out methods for maintaining and highlighting quality in education. It has also been well accepted that unless the educational system in any nation keeps pace with the accelerated technological change, there
is bound to be stagnation and regression.

Earlier period of the history of teaching modes has been marked by verbal domination of the teacher. The children were taught and provided instructions orally. This mode was an instrument to test the retention power or memory of the learner. In this type of instructions, the performance of students was assessed after the end of a certain grade or time duration. This mode in which the teacher plays the major role, is the pivot of educative process. Here main emphasis is laid on providing information and rote memorisation. Such modes are known as teacher centred modes like the lecture mode and historical mode. Kuppuswamy and Natrajan (1988) identified some drawbacks of lecture method namely- over emphasis in content, testing for grades and not evaluation, passive student involvement and inability to deal with individual learning problems.

Now-a-days, picture on the educational scene is changing. The central point is pupil instead of teacher. The passive attitude, disinterest and non involvement of pupils, all this arise from routine methods which prevent them from fully comprehending and understanding the information given to them. In contrast to such teaching modes, Bruner (1966) recommended the concept attainment model i.e. teaching the
concept and motivating the powers of inquiry in the pupils. He emphasised on problem solving approach. Carl Rogers also emphasised the quality of human interaction and the degree of interpersonal intimacy in classroom. Having a view of different teaching models, it is seen that each of these has some significance and teaching is not exclusively one or the other. Whatever model a teacher has in view, there can be integration of teaching technology with teaching methods to achieve the educational goals successfully and effectively. In present times, the students should not be taken as a vessel waiting to be filled up with facts. The modern idea is to help the child to learn. The modern teacher realises that, "to teach is to nourish or cultivate the growing child". It is in this area that the role of instructional technology assumes vital importance. The teacher of the past could communicate through the spoken and/ or written word. But the teacher in modern times has been enriched with so many newer techniques and strategies to achieve the goals of education. The utility of these new techniques is significant, if the problems arising from qualitative expansion of school population, heterogeneity of pupils in schools, divergent needs of pupils coming from different socio-economic and cultural areas, knowledge explosion and social change due to modernisation (industrialisation) are to be solved by the teachers of today. These new values and new techniques are very important not only in India but
throughout the world. Eventually innovation has become a permanent feature of the educational scene. This is particularly true in the fields of science and technology education where developments are proceeding at an ever-increasing pace, not only in curriculum content, but also in the associated teaching methods and materials. The scope of innovations in science covers the teaching of various scientific disciplines—physics, chemistry, biology and mathematics—integrated and interdisciplinary science. These innovations have been so spectacular that Eric Ashby (1967) has identified these as four revolutions in the field of education:

(i) The first revolution occurred when societies began to assign different roles to adults and the process of education was shifted from parents to teachers and from home to 'school'.

(ii) The second revolution was the introduction and adoption of 'written word' as tool of education. Prior to that education was provided orally.

(iii) Invention of 'printing' brought about third revolution. All knowledge was started to be stored and disseminated in the form of books, papers and magazines.

(iv) The introduction of 'electronics' in the form of radio, television, video, computer, teaching machines and closed circuit television etc. has made the fourth
revolution in educational fields.

Now-a-days electronic medium has taken precedence over the rest. Therefore, we can observe that television, video and calculators are being taken as playthings. Regarding the use of media in educational fields Wilbur Schramm (1973) in his study "Big Media-Little Media" mentioned that the developing countries specifically use the media to raise the quality of instruction and even good teaching is often supplemented by these media. The use of big media and little media has extended the scope of education to areas which to the schools and teachers were not otherwise accessible. Schramm (1973) classified big media on the basis of cost and complexity of instrument. Big media imply the costly and more complex device such as television, video, and computer whereas little media are less complex and costly e.g. radio, tape recorder, charts, transparencies, maps etc. Coombs (1985) observed that the term educational technology is often equated with the new media and electronic devices that have grown out of the post war communication revolution like transistors, radio, television, audio and video cassettes, teaching machines, language laboratories, computers and communication satellites.

1.1.3 **Radio broadcast**

An effective medium of instruction is school
broadcast. This broadcast has generally two objectives of providing (a) general information and (b) specific information in the form of teaching. Expert teachers are engaged in preparation and delivery of programmes for school broadcast. The usefulness of radio has been pointed out by various studies. Lumley (1933) found that pronunciation of the students taught by radio were better than the ones who were not. Radio has been found to have advantage in terms of cost, time and localisation by McAnny (1973). Jamison and Klees (1975) reported that it is about one fifth as expensive as educational television. Bates (1984) discovered that 92 percent of schools in United Kingdom had radio set. 90 percent of these schools used school broadcasts. Sharma and Tripathi (1979) reported that difficult portions of subject like mathematics can be divided into subunits, arranged in sequences in a systematic manner and thus its broadcast can make the subject lively. Also Sharma and Tripathi (1980) conducted an experiment on the students of tenth class of central school, Surat, to see the effect of radio broadcast on the teaching of history. The results revealed that radio broadcast method was a better medium as compared to traditional classroom instructional method in terms of pupil's achievement. Sudame, Biswal and Sahoo (1982) studied the effect of broadcast programmes for better teaching of geography on secondary school students. The results were derived from the achievement of students by
administering the same criterion test on both the control and experimental groups. The results showed that radio-vision mode was better for teaching geography. Dhamija (1985) established that the achievements of students in geography was maximum with radio-vision approach. On the other hand Goel (1982) found that school broadcast units were not functioning properly. The school teachers were not utilising school broadcast adequately. They were also not trained for the purpose. Inadequate training of teacher-trainees at pre-service level for these school broadcasts was also felt by Mohanty (1984).

1.1.4 **Educational television and video**

Educational television has become a very powerful audio-visual aid. Beach (1974) found that educational television exposes students to a variety of effective verbal ways and communication situations. The use of television in educational fields is increasing day by day. The experiences provided by television cannot be provided by any other device. Through television, it is possible to show movements and actions. In physics, chemistry and biology there are various complicated or dangerous experiments which cannot be demonstrated in the classroom conditions. Recording of such cases through video camera under special laboratories controlled conditions has proved quite useful. It has been
found that through lens we can have close-ups and other microscopic details of various organs of body and organisms which become clearer as compared to when seen through the naked eye. Through television and video it is possible to have slow motion, search facility in the form of fast forward and rewind of the tape. These facilities of instant replays, stop, slow motion, pause, and split screen techniques have increased the versatility of television, which is in corcondance with Beach (1974).

Educational television has been felt a necessity throughout the world. Bates (1984) in a survey of educational broadcasting in U.K. discovered that in the year 1982, 97 percent of the schools and Further Education Colleges had television sets. The schools used programmes of the British Broadcasting Corporation (94 percent) and Independent Television Networks (84 percent).

There have been some researches to note the effectiveness of educational television. Gordan and Costello (1961) found the use of television for large classes. According to them, good education could be imparted to more people at lesser cost per student. Tyler (1965) also suggested that television helped in providing good quality of education. Khanna (1967) conducted an experiment to study the effectiveness of the closed circuit television in medical sciences. He compared the effectiveness of closed
circuit television with direct observation method. The results revealed that observing surgical operations through closed circuit television is more effective than the direct observation method in operation theatre. Goodlad (1969) held that teacher alone can not impart good education. Use of television helps in providing good quality of education by bringing expertise from various fields of education. The effectiveness of audio cassettes and video cassettes has been studied by Wetstone and Friedlander (1974) for the live classroom presentation. Highest comprehension scores were obtained by the group who was put to the video tape presentation whereas poorest performance was elicited by the group who had to go through audio cassette presentation. The audio cassette presentation was found to be non effective even than conventional classroom presentation. Mayo et al (1975) conducted an experiment to study the effectiveness of instructional television. A gain of 15 to 25 percent was found on the general ability test of students as compared to their non-instructional television group of students. Extremely high passing rate of students was confirmed by Divcira (1976) through the introduction of television. Solomon (1979) pointed out that television is particularly rich in the quality and variety of information it conveys. It uses a wide variety of symbol systems- sounds, pictures, colour and movements. Neuman (1980) investigated that
television is helpful in improving the listening skills of older and more intelligent students. Sharma (1961), and Sharma and Singh (1981) also found educational television (ETV) useful. Abroad, Maftoon-Semnani (1981) discovered that television lessons in U.S.A. were more used in lower classes than in the higher ones. Sudame and Goel (1984) studied attitude of students of various states of India towards ETV programmes and reported that the students of Maharashtra state favoured ETV programmes. Sharda (1985) made an investigation into the relative comparison of programmes produced by various agencies and reported that locally produced programmes at Hyderabad were better than NCERT produced programmes.

These studies by Costello (1961), Tyler (1965), Khanna (1967), Goodlad (1969), Wetstone and Friedlander (1974), Mayo et al (1975), Divcira (1978) and Neuman (1980) reported that television is more effective medium of instructions than the conventional class room teaching. But the other side of the coin was also presented by some investigators like Roy (1974) and Lockett (1981) who did not find any success through television programmes. Roy found that 50 percent of students of Delhi TV centre could not have overall cognitive effects.

Mankiewicz and Swerdlow (1978) revealed that through the use of television, pupils' attention was diverted
easily. They reported that to hold the attention even for two minutes was difficult when the teacher was busy in arranging some films or slide or like. Larrick also supported it that the children who watched television, not only had shorter attention period but seemed to thrive on noise and confusion also. Kemelfield (1976) held the belief that children could not simultaneously look and listen with equal absorption on television.

These researches exploring the effectiveness of television as an approach to teaching establish that it can be effective medium to impart knowledge and improve psychomotor skills but it cannot be treated as an effective approach when considered as attention retaining medium. This shortcoming can be removed if the potentialities of other gadgets- like video were used in combination with the potentialities of television.

The use of video and other multimedia devices has been found quite useful by some investigators. The multimedia approach may consist of packages of models, audio and video-cassettes, slides, pictures, and charts etc. Use of multimedia packages was studied by Kumar (1982). He compared the effectiveness of three methods viz expository, programmed learning and multimedia on retention power of students and found multimedia approach to be more effective.
than expository method or programmed learning.

The studies by Puryear (1973), Singh (1975), Kumar (1977) and Chhabra (1978) revealed that learning is more when two media (tape and projection) are used in combination rather than any single medium.

Television technology consists mainly of three activities—production, transmission and reception of programmes. These programmes are developed in studios or in outdoor shooting. Expert teachers are engaged in their production. First of all, script is written keeping in view the content matter or text. All the necessary material is collected in the form of real objects, models, charts, picture, film slides or film clips. After the arrangement of required material and script, the expert teacher delivers the lesson through demonstrations. Recording is done and after editing, the final lesson is then transmitted through the TV station. The schools are provided time-schedule so the they can make arrangements for the students to observe these lessons.

Video technology here helps in preservation and further distribution of programmes. It is quite easy to record any programme, erase it and then again re-record it many times. These video cassettes can be easily carried from one place to another.
In India, school transmission was started in October 1961. Televised lessons for Delhi schools in four subjects—Hindi, Physics, Chemistry and English for class IX were started. The Satellite Instructional Television Experiment (1975-76) was observed in 2,400 village schools situated in 21 districts of six states viz Andhra Pradesh, Bihar, Karnataka, Madhya Pradesh, Orissa and Rajasthan. Now-a-days a network of transmission stations and reception centres have been established throughout length and breadth of the country. These centres are relaying educational programmes through INSAT 1D. The Central Institute of Educational Technology, New Delhi produces a good quality of programmes both for primary and secondary schools. In 1984 the University Grants Commission also started educational television programmes on national network. These educational programmes for higher education have also been produced by Indian Institute of Mass Communication, New Delhi, Indira Gandhi National Open University, New Delhi, Educational Media Research Centre, (EMRC), Hyderabad, and Audio Visual Research Centre, (AVRC), Poona etc. These programmes are also available on the video cassettes.

Audio and video recording in the form of cassettes has a major impact on the educational broadcasting. The most important aspect of both audio-and video-cassettes is the control over the medium that they offer to the learner
compared with broadcasts. Durbridge (1981) reported that students feel much convenience in the use of audio-cassette as compared to the broadcast. He found that students frequently comment that listening to an audio-cassette is like having a personal tutorial in their own room with the course author, a quality which is not found in most radio programmes. Bates (1979) also pointed out that there is no real need to broadcast radio at all, since all programmes could be mailed on tape at very low cost. Bates et al (1982) and Grundin (1980) compared the relative helpfulness of radio broadcast and cassette to students. They revealed that cassettes were more helpful to the students even when these were originally made for radio transmission. On a five point scale (with 5 = very helpful), the mean helpfulness rating for radio broadcast in 1979 and 1980 was 3.42. When the same material was used on cassette, the helpfulness rating was 3.79.

When we compare the effectiveness of broadcasts and cassettes in terms of integration with other material, the ease in recalling the matter, deep thinking, broadcasts appear to be much weaker instructionally than cassettes. Bates (1984) realised the difficulty for a learner to integrate or relate television broadcasts to other learning material because of the need to catch the broadcast at a fixed time and the impossibility of stopping or interrupting
a programme at a certain point. He pointed out that if any ideas or thoughts are stimulated during a television broadcast, learners run the risk of either loosing the thread of the programme or being unable to follow through their own thoughts. He compared the control characteristics of broadcast television and control characteristics of recorded material (cassettes). The broadcasts had the following implications for learners viz - fixed time to view, limited response to material, non-repeatable, continuous broadcast making thinking 'on-the-run', no room for individual differences to be satisfied whereas the recorded material (cassettes) was found to have the following implications for the learners like- convenient in availability, rewind/fast forward facility helps in the instantaneous review of the lesson, due to 'pause' facility integration with other media is possible, individual differences can be satisfied, due to non-continuous/segmented recording- analysis and restructuring of the lesson is easier.

1.2.0 Emergence of the Problem

Today tremendous growth has taken place in all the spheres of educational activities. It is said that wisdom is the fruit of a balanced development. It is this balanced growth of individuality which should be the aim of
education. For accomplishment of all round development of pupils, any good teacher uses appropriate teaching strategies and audio-visual material in support of his teaching. Sharma (1973) in an evaluative study of the curriculum in agriculture at the high school level in Punjab, suggested that for better development of students, new teaching methods should be used. According to New Education Policy (1986), "If we want our students to enter into the twentyfirst century, with latest and up-todate scientific knowledge, suitable technologies need be introduced into the educational system". In order to study the effectiveness of any new particular mode for the presentation of instructions, various researchers have compared that particular mode with conventional mode of teaching. The effectiveness of new modes of teaching like programmed learning, modular approach, radio, television, video instructions and multimedia approach etc. was studied by investigators like Gautam and Sachdeva (1989), Rao (1986), Singh (1985), Allan (1985), Dubey (1984), Sharma (1983), Kumar (1982), Sansawal and Joshi (1981), Oberoi (1981), Sharma and Tripathi (1980), Bannerjee (1976), Mayo et al (1975), Merwin and Schneider (1975), Wetstone and Friedlander (1974), Kaushik (1968), and Shah (1964). These investigators compared the effectiveness of new approaches versus conventional approach. The results of these studies showed that new approaches or modes of teaching were found
to be more effective as compared to the conventional ones.

There are several researches conducted to evaluate the comparative effectiveness and effect of different approaches of instructions for science subjects. The researches made by Thomas Snider (1969), Egelston (1973) and Sakmyster (1974) revealed that the deductive approach in teaching of science had a significant effect on the achievement of students. Lahnstone (1973) compared directed discovery strategy with demonstration strategy in geography in developing certain concepts and found directed discovery strategy significant. Trope (1974) established the superiority of individual discovery over external direction. Linz (1973) made a study of relative effectiveness of inductively and deductively sequenced modes of teacher centred presentation in chemistry at high school stage and discovered it to be significantly better. Hermann and Hincksmann (1977) also found inductive and deductive methods in teaching of chemistry useful. Cunningham (1947), Mallinson (1947), Ceutter (1966) and Goldstein (1973) made investigations regarding comparative efficiency of different methods of instructions in science. Cunningham (1947) conducted a study for comparing lecture demonstration method with individual laboratory method in science teaching. Nalliah and Adinarayan (1977) conducted a comparative study of traditional method and programmed instructions in
teaching physics at tenth class and found programmed instructions better than traditional method. Gupta and Gupta (1979) also confirmed it by making an experimental study of programmed instructions of teaching chemistry. Muddu (1978) made a survey of status of instructional procedures in biology in high schools of Hyderabad and Secunderabad. The investigator reported that only lecture-demonstration method was preferred by most of the teachers. Swarnamma (1978) investigated that most teachers resorted to lecture-demonstration method in the teaching of biology in the upper primary schools of Kerala. Sharma (1978) studied the concept formation in natural science and reported that guided activity was more effective than self-activity. Dev (1979) concluded that teachers were more interested in using lecture method than any other instructional method in secondary schools of Nagaland. Gupta (1979) examined analytico-synthetic (A-S) method with narration-explanation (N-E) method and reported that for the teaching of geometry, analytico-synthetic method was more effective than narration-explanation method. Jha (1979) found activity based approach superior in performance after comparing different methods of teaching biology at high school stage. Sivadasan (1979) evaluated the effectiveness of different classroom situations on the achievement of objectives of science education. Sahajahan (1980) designed and developed
modules of teaching science for standard VI and VII. He found that the modular way of learning was more effective compared to conventional method of teaching. In a similar study, Hopper (1982) designed and developed modules of standard XI for teaching biology. He found that all the three structured modular approaches of teaching viz-self learning, peer group learning and peer group learning with teacher intervention were effective regarding cognitive achievement. Mohammad Miyan (1982) studied the effectiveness of three methods viz- tell and do, guided discovery and pure discovery on teaching of mathematics regarding developing mathematical creativity. He found that the guided discovery method was most effective in promoting originality as compared to tell and do method or pure discovery method.

There are various presentation modes for teaching science at various levels namely lecture mode, demonstration mode, lecture-cum-demonstration mode, heuristic mode, project mode, laboratory mode, assignment mode, problem solving mode and historical mode. The explosion of knowledge all over the world has brought about changes in methods of teaching of all subjects like science, arts, commerce and humanities. Not only in India but throughout the world, innovation has become a significant feature on educational scene especially in science. The innovations explore the integrated and interdisciplinary science

In the prevailing Indian conditions, there is need of those presentation modes which are easier to plan
and administer within our given resources. In the present study, an endeavour has been made to study the effect of four presentation modes on the achievement of secondary students in science. The four modes chosen are Demonstration mode, Video instructions mode, Video instructions followed by teacher's discussion mode and Students' learning through self-experimentation under the guidance of teacher mode. Studies of trend reports, various journals and abstracts and Surveys of Research (Buch 1974, 1979 and 1986) reveal that very little work has been done to investigate the effect of these four presentation modes on achievement of secondary students in physics, chemistry and biology. Hence it will be worthwhile to study the effect of these above presentation modes on the achievement of secondary students in science, as the findings of the investigation may prove helpful in the emergence of a new educational pattern, which may ultimately prove helpful in the progress of the nation. It was with this view that the present study was planned and conducted.

1.3.0 STATEMENT OF THE PROBLEM

The problem for the present investigation is stated as under:

EFFECT OF FOUR CLASSROOM PRESENTATION MODES ON THE ACHIEVEMENT OF SECONDARY STUDENTS IN SCIENCE.
DEFINITIONS OF TERMS USED

One significant term used in the statement of the problem is 'Presentation Mode'. It means the ways of exposition or delivery of instruction to the students. The different presentation modes can be broadly categorised into teacher centred modes and pupil centred modes. Lecture method and historical method are examples of teacher centred mode while heuristic method, project method and discussion method etc. are examples of pupil centred mode. The presentation mode may be expressed as the process of interpreting the world of knowledge, just as a way of educating. In the present venture, four presentation modes were selected viz Demonstration mode, Video instructions mode, Video instructions followed by teacher's discussion mode and Students' learning through self-experimentation under the guidance of teacher mode. The effectiveness of each mode was studied on the achievement of students of tenth class in physics, chemistry and biology.

Another term used in this connection is 'Achievement'. Achievement is something gained by someone in his field. Various people show achievements in different fields like academic, sports, economic, political and science etc. Good (1973) in his dictionary defined achievement as academic knowledge attained or skills developed in the school
subjects, usually designed by test scores or by marks assigned by the teachers or by both. An achievement test is used as a tool for measuring the nature and extent of student's learning in a particular subject or group of subjects. How far a particular student has been able to learn or acquire or has been benefitted from learning experiences given to him, is ascertained with the help of these tests. In the present investigation, achievement signifies the scores of students on the Achievement test in physics, chemistry and biology.

1.5.0 DESCRIPTION OF EACH MODE SELECTED FOR THE STUDY

The investigator selected four presentation modes for the present investigation namely:

(a) Demonstration Mode (DM)
(b) Video instructions Mode (VM)
(c) Video instructions followed by teacher's discussion Mode (VDM)
(d) Students' learning through self-experimentation under the guidance of teacher Mode (SLM).

1.5.1 Demonstration mode (DM):

This mode is an effective combination of verbal ability and performance skill. Many teachers consider it as the best mode of teaching sciences. Science is a systematic and organised body of knowledge. It comprises various
scientific facts, concepts, generalisations, laws and theories. Science are taught at school stage with the aim of inculcating in the students scientific attitude and scientific method of working. It also aims at imparting knowledge about our environment, our lives and our lifestyle. Demonstration mode provides such learning experiences which are in accordance with the above said aims of teaching sciences. Science can not be told or talked about. Here the students have to have a picture of what is truth? The demonstration mode overcomes the practical limitation of resources and time. This mode is an integrated approach to theory and practical. The practical demonstration in the form of experiments, display of models, charts, slides and pictures etc. are in consonance with the teacher or content matter of the topic. Demonstration mode takes into consideration the active participation of the teacher and pupils. This mode provides real experiences to the students which cannot be provided through the lecture only.

Kuppuswamy and Natarajan (1988) reported the significance of demonstration mode and suggested the use of copious visual aids to reinforce the auditory message. They remarked that the use of overhead projector, slides, blackboard, short films or a live demonstration helps to arouse students' interest as well as to provide an alternative learning for the large number of students who
are not good auditory learners. Muddu (1978), in his UGC financed study on the prevalent status of instructional procedures in biology in high schools, found that most teachers preferred only the lecture-demonstration method for the teaching of biology.

1.5.2 **Video instructions mode (VM):**

Video is emerging as an effective medium of communication for imparting educational instructions. It is very useful for educating the masses in developing countries like India where a large number of people are still illiterate. Through video, a standard quality of information and knowledge, in the form of educational programmes, can be communicated to the people. These programmes can be recorded on video-cassettes with the consultation of subject expert. It is a boon if used properly in education as no other audio-visual system allows the recording of both sound and moving image and playing of them back so immediately. Video has a high motivational and reinforcement value, as it exposes the learner to both the audio and the visual discourse simultaneously (Gautam and Sachdeva, 1989).

The effectiveness of video was felt by Bannerjee (1976), Dubey (1984), Rao (1986) and Singh (1985) as an important and potential medium which combines visual technique, with interpersonal communication, where complex
demonstrations can be recorded beforehand; the recorded material can be erased and then again re-recorded. The search facility helps the user to repeat the main points again and again.

The potentialities of video were also explored by Allan, M. (1985) in the field of teacher education. He revealed, "The big advantage of video in teacher-training is that it gives trainees access to range of classroom they could not otherwise enter". An essential part of teacher-training is demonstration lesson. Some of the practical difficulties were realised by Mohanraj (1989). He found that the live demonstrations take a lot of time and lack in variety in skill-performances. Use of video in these circumstances is quite useful. Recording and editing of a few real class skill-demonstrations helps in highlighting the necessary information to be imparted to the trainees. The video is more advantageous in these conditions than television as the latter cannot be interrupted and not retrieved to suit the needs of the learner. Allan (1985) also comments that a live demonstration is an 'ephemeral occasion', by recording it a longer lease of life is given to it.

These researches indicate that video as a medium of instructions offers a good potential for imparting and
improving the quality of education. The software for video tapes is prepared by the Electronics Trade and Technology Development Corporation (ET&T) under a 'TELETEACH' project. Nearly 600 viewing centres in schools are to be established with video cassette recorders and other accessories. The non formal education can well be equally benefitted with this video mode making it possible for the learner to carry out their studies at their own pace. This video instructions mode is becoming very important tool in Distance Education.

For the execution of video mode, first of all script of the topic is prepared with the help of subject and language expert. All the necessary information which is to be presented, is collected. This information can be in the form of print material, talk or speech by some person, slide or film strip etc. The material in the form of real objects, models, charts and experiments all are beforehand kept ready. The teacher starts teaching. All the activities which the subject teacher does, are recorded in a video cassette with the help of video camera. This is called as video lesson. This video lesson is then shown to the school students. All the students are informed about the general nature of the topic and suitable instructions are given to them e.g. to keep your pen and notebooks ready and note down the important points. Whenever need arises for certain clarification to be made, the cassette is played back. In
the video instructions mode, the students are shown video lesson. They are allowed to understand and learn on their own. In this particular mode, there is no discussion made by the teacher. Only the instructions are provided through this video instructions mode.

1.5.3 Video instructions followed by teacher's discussion mode (VDM):

In this mode, the subject teacher discusses the content matter delivered through the video lesson. The students, in the beginning of video lesson, are asked to keep the notebooks ready and note every important aspect or point coming during the lesson. The teacher provides the feedback in the end and recapitulates the lesson by asking specific questions related to the topic. The students are sufficiently motivated to participate in the discussion. Any point which is to be explained or elaborated, is played back on the television. As in the case of VM, the tape can be made to freeze, whenever there is some written matter on the screen so that students may note it down.

The differences between these two video modes lies in the discussion as an activity at the end of the lesson or during the lesson. In VM the students are allowed to observe the video lesson and note down the points. The teacher does not give any explanation. In VDM the teacher discusses the topic so as to clarify any issue and test the understanding
of students through recapitulative questions.

1.5.4 Students' learning through self-experimentation under the guidance of teacher mode (SLM):

The major principle of this mode is to "help the pupil to help himself". In this mode the teacher has to constantly watch the progress of each student. The teacher should continue to move in the class to see the students doing their study or any experimentation. It is sometimes important to locate such students who need help but hesitate to ask for it. With the help of constant observation, such individuals who have any difficulty, can be located.

The second principle is to keep all students busy through the period. When any student faces a difficulty he may lose interest and quit his work, if that difficulty is not removed well in time. The pupils should be encouraged for their achievements because this motivates the pupils to do more and better work. Hoff (1950) found that a supervised study period of 30 to 40 minutes is generally successful in a junior high school and the duration can be more i.e. from 50 minutes to one hour for the students of senior high schools. Hopper (1982) reported that self-learning modular approach was more effective in teaching biology as compared to peer group learning and peer group learning with teacher intervention.
The methodology for this mode includes the use of text-books of physics, chemistry and biology as study guides. Along with it teacher's guidance and supervision is quite essential because lack of supervision can lead the students in doing unwanted activities. There are different approaches of SLM. Sometimes all these different approaches may have to be used at different times and with different pupils because same procedure may not suit equally well to all the students. This differentiation in suitability arises due to the difference in intelligence, reading ability, interest, attitude, resourcefulness and physical vitality of the pupils. It has been found effective to ask the students to have a trial of different approaches in order to observe the effectiveness of each different approach. This can help the students to choose the most effective method for himself.

The first method told to the students is to read the entire chapter in the text and then attempt to answer the questions given at the end for performance assessment. The prior reading of the content matter will be helpful for the students in locating the answer and explaining it accordingly. The answers of which he is uncertain can be found easily by rereading the content. Repeated reading can be helpful in searching the required information.
The second method told is to divide the entire content of the chapter into smaller topics and reading it. After reading the certain portion or paragraph or frame, the pupil is required to answer the questions based on that very particular smaller portion or frame of the chapter. When the question is answered, the pupil may go to the next stage i.e. he may read the next portion of the chapter. This process is repeated until the pupil covers the full chapter. This method is quite useful for pupils of lower mental and reading ability (Hoff, 1950).

The third, although not so often recommended, method was to have a glance at the questions first and then search the answers. This method can be adopted by pupils of lower ability and who lack interest in reading the whole unit, if the proper supervision is not provided by the teacher. This particular third method inhibits the development of reasoning among the students and the pupil try to locate the answer keeping the specific question in mind.

It was considered that it would be best to let the students decide which method or approach works best for them and which they prefer to use. At all stages, required material was made available to students to perform experiment mentioned in the text. Individual attention was paid as far as possible.
Along with the reading of text and performing experiments, it was made clear to the pupils to write their results on paper. Sometimes the pupils may be sitting and looking at a book but not reading at all. At this stage their written experiences and results can be helpful in estimating the progress.

The SLM has several advantages like:

1. It provides supervision of study of the students by the teacher.
2. The pupil can immediately be helped whenever he seems to be confused or in difficulty.
3. This takes into consideration the psychological principle "learning by doing". The understanding is more stable when the students do some work on their own.
4. Home task can be reduced through the use of this mode.

1.6.0 Reasons for selecting the above said modes for this investigation:

The aim of this investigation is to study the influence of four presentation modes on the achievement of secondary students in science where achievement is the actual change in the cognitive ability of students due to the teaching of sciences. If such modes or methods are used which emphasis only one principle and neglect others, change
in only some aspects of cognitive ability of students is expected. The above said modes, are such that they can bring out changes in all the aspects of cognitive abilities of students. In addition, these methods which have been selected for the study are such that each one of them can be used independently to teach almost all the topics of physics, chemistry and biology. If such methods are selected which cannot be used independently or which can be used only in combination with other methods, it will be difficult to study the effect of these modes on the achievement of students in science. Hence the modes, which have been selected for this research, are such that they can be used in actual classroom situations for teaching the subjects of physics, chemistry and biology of secondary stage independently.

1.7.0 OBJECTIVES

The study envisages to achieve the following objectives:-

(1) To compare the pupils' achievement in science adjusted on intelligence, socio-economic status and pre-achievement in science, taught through Video instructions followed by teacher's discussion mode (VDM) and Demonstration mode (DM).

(2) To compare the pupils' achievement in science adjusted on intelligence, socio-economic status and pre-
achievement in science, taught through Video instructions followed by teacher's discussion mode (VDM) and Video instructions mode (VM).

(3) To compare the pupils' achievement in science adjusted on intelligence, socio-economic status and pre-achievement in science, taught through Video instructions followed by teacher's discussion mode (VDM) and Students' learning through self-experimentation under the guidance of teacher mode (SLM).

(4) To compare the pupils' achievement in science adjusted on intelligence, socio-economic status and pre-achievement in science, taught through Demonstration mode (DM) and Video instructions mode (VM).

(5) To compare the pupils' achievement in science adjusted on intelligence, socio-economic status and pre-achievement in science, taught through Demonstration mode (DM) and Students' learning through self-experimentation under the guidance of teacher mode (SLM).

(6) To compare the pupils' achievement in science adjusted on intelligence, socio-economic status and
pre-achievement in science, taught through Video instructions mode (VM) and Students’ learning through self-experimentation under the guidance of teacher mode (SLM).

1.8.0 HYPOTHESES

H1 There is no significant difference in the mean achievement scores of secondary students in science, taught through Video instructions followed by teacher’s discussion mode and Demonstration mode.

H2 There is no significant difference in the mean achievement scores of secondary students in science, taught through Video instructions followed by teacher’s discussion mode and Video instructions mode.

H3 There is no significant difference in the mean achievement scores of secondary students in science, taught through Video instructions followed by teacher’s discussion mode and Students’ learning through self-experimentation under the guidance of teacher mode.

H4 There is no significant difference in the mean achievement scores of secondary students in science, taught through Demonstration mode and Video instructions mode.
H5 There is no significant difference in the mean achievement scores of secondary students in science, taught through Demonstration mode and Students’ learning through self-experimentation under the guidance of teacher mode.

H6 There is no significant difference in the mean achievement scores of secondary students in science, taught through Video instructions mode and Students’ learning through self-experimentation under the guidance of teacher mode.

1.9.0 DELIMITATIONS OF THE STUDY

The present study has the following delimitations:

1. The study could be conducted on any secondary class but it has been delimited to the tenth class only.

2. Although there are various presentation modes but the study has been confined to four presentation modes only viz- demonstration mode, video instructions mode, video instructions followed by teacher’s discussion mode and students’ learning through self-experimentation under the guidance of teacher mode.

3. The impact of these presentation modes has been studied in case of three branches of science only i.e. physics, chemistry and biology.
1.10.0 ORGANISATION OF THE REPORT

The report of the present investigation has been divided into five chapters. A birds' eye-view of these chapters is as follows:

CHAPTER 1 INTRODUCTION

In this chapter vitality of science for our life, progress of science as a historical perspective, present position of science teaching, introduction of new modes, emergence of the problem, statement of the problem, definitions of key terms, description of each presentation mode, reasons for selecting the modes for the present study, objectives, hypotheses and delimitations have been given.

CHAPTER 2 REVIEW OF RELATED LITERATURE

In this chapter a survey of the literature related to the present study has been made.

CHAPTER 3 METHOD AND PROCEDURE

In this chapter the sample, tools and procedure for data collection and statistical analysis have been given.

CHAPTER 4 RESULTS, INTERPRETATION AND DISCUSSION

This chapter contains the analysis, interpretation and discussion of results obtained.
CHAPTER 5 FINDINGS, CONCLUSIONS, EDUCATIONAL IMPLICATIONS AND SUGGESTIONS FOR FURTHER RESEARCH

In this chapter findings of the investigation, the conclusions drawn from the findings, their educational implications and suggestions for further research have been given.

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