CHAPTER-I

INTRODUCTION

Globalization and technological change processes that have accelerated in tandem over the past years have created a new global economy —Powered by technology, fueled by information and driven by knowledge. The emergence of this new global economy has serious implications for the nature and purpose of educational institutions. As you know the half life of information continues to shrink and access to information continues to grow exponentially, schools can not remain mere venues for the transmission of a prescribed set of information from teacher to student over a fixed period of time. Rather Schools must promote —Learning to Learn i.e. the acquisition of knowledge and skills that make possible continuous learning over the lifetime. —The illiterate of the 21st century according to futurist Alvin Toffler, —Will not be those who can not read and write, but those who cannot learn, Unlearn & relearn, Concerns over educational relevance and quality co-exist with the imperative of expanding educational opportunities to those made most vulnerable by globalization - developing countries in general, low income groups, girls and women and low skilled workers in particulars. Global changes also put pressure on all groups to constantly acquire and apply new skills. The international Labour organization defines the requirements for education and training in the new global economy simply as a —Basic education for all, —Core work skills for all and —Lifelong learning for all. In this connection, Information and communication technologies (ICTS) which include radio and television, and the Internet - have been touted as potentially and powerful enabling tools for educational change and reform. When used appropriately, different ICTS are said to help expand access to education, Strengthen the relevance of education to the increasingly digital workplace, and raise educational quality by, among others,
helping make teaching and learning into an engaging, active process connected to real life.

There are so many rapid and significant developments in the field of knowledge technology. These developments serve human being in number of ways. Today knowledge technologies became basic components in either exploration-implementation-evaluation process or personal and financial affairs. Many fields should closely follow these new developments in knowledge technologies in order to benefit from them. One of these fields is education.

The World Development Report for 1998 has most appropriately focused on 'Knowledge for Development' (World Bank, 1998). The report highlights various attributes of knowledge that differentiate the developing countries from the developed. The report highlights that acquiring knowledge is as important as its absorption and communication. It also shows the widening disparities between the developed and developing countries as far as the development and application of ICTs is concerned. Estimates have shown that in 1993 there were approximately 173 million computers in the world and nearly 43 percent of these computers were being in use in USA alone. Another 40 percent of computers were used in the other 17 large industrialised and developed countries such as Japan, Germany, UK and France. This leaves nearly one-sixth of the computers, in use in the remaining 200 countries of the world (Williams, 1998). The developing countries, therefore face an uphill task to develop and deploy the large scale IT applications in education, research and administration.

Education, as a producer of knowledge, is frontrunner and spearheading ICT related developments. The curriculum in developed countries, at all levels of education, has been redesigned and places greater emphasis on the use of ICTs. The educational systems of
developing countries are still recovering from the shock waves of the ICT revolution that has already taken place in the developed world during the last two decades. Can the developing countries face the challenges which the last decade of the present millennium poses? These questions cannot skip the attention of development planners in developing countries even with a vision of 3-5 years. The second role for the education sector is to use these technologies for improving its managerial efficiency and effectiveness. The education sector, perhaps the most mismanaged social sector, is characterised by managerial inefficiencies of high order.

The Indian education system, even after 50 years of independence, continues to be largely colonial in character although the efforts to modernise, restructure and make it responsive to the emerging needs of the developing economy have succeeded to some extent. The country is still faced with the challenge of mass illiteracy and low quality of educational output at all levels. There are more than 300 million illiterate and about 60-80 million children of age less than 10 years do not attend school regularly. The quality of education, even at the primary stage, is below the prescribed standards and only a few students cross the threshold of prescribed competencies. The persistence of the colonial characteristics is clearly manifested in the present day inspection and supervision styles of school education. The bloated belly of higher education and persistence of amorphous arts and humanities sector is a matter of concern. There are few islands of excellence in the vast ocean of mediocrity. There is hardly any link between the curriculum and the requirements of the world of work. Improving the relevance and effectiveness of education is a major challenge facing the development planners.

The education sector not only acts as a trend setter for the social and economic development by producing the skilled manpower but also is the largest employer of educated and qualified manpower. What is
being taught today in the institutions of higher education will be a major determinant of the productivity and quality of the workforce in the coming years. The persistence of illiteracy and low levels of educational attainment among the workers of 2020 will be a major curse for any country. With rapidly changing technology and ever increasing application of ICTs, the deskilling of labour force has already started. Next 10-20 years will be very crucial from this point of view.

During 1960s and 1970s, the developing countries received technical assistance from developed countries for improving their technological base. Considerable assistance was available for the purchase of foreign manufactured hardware. Various studies showed that the primary beneficiaries were the foreign companies that provided the equipment. This gave rise to a debate within the UNESCO and the United Nations General Assembly about the efficacy of foreign technology. Considerable thought was also given to the need to maintain balance between technical assistance and the human resource development to use these technologies. Eventually a New Information and Communication Order was formulated which provided the framework for the development of ICTs in developing countries. Following this and related developments, in 1980 the UNESCO General Conference initiated the international program for the development of communication.

The use of Information and Communication Technology (ICT) will enhance the quality learning process (Voogt and Pelgrum, 2005). ICT is defined as the combination of informatics technology with other technology modalities. ICT will be used, applied, and integrated in activities of teaching, learning and management on the basis of conceptual understanding and methods of informatics (UNESCO, 2002). In addition to the use of ICT to improve learning, the emergence of the knowledge economy has also brought in recent years
a much greater emphasis on educational, and master plans on ICT in education have also been produced in many countries.

According to the *European Commission (2002)*, all citizens of the European Union should have the possibility of acquiring so-called key skills, which include digital literacy and higher order skills. Such master plans detailed not only implementation strategies but more importantly embedded the plans within a broader framework of education reform aimed at developing student capacity for self-learning, problem solving, information seeking and analysis, critical thinking and the ability to communicate, collaborate and learn via the Internet, abilities that figured less importantly in the school curriculum before (quoted by *Tearle, 2003*). An international study of classrooms innovating with ICT in 26 countries found a very wide variety of applications and pedagogy. The common thread was an emerging paradigm of lifelong learning (*Pelgrum and Anderson, 1999*).

In this age of Information and Communication Technology (ICT), there is growing concern for the use of ICT resources such as the computer, scanner, printer, Intranet, Internet, e-mail, videophone systems, teleconferencing devices, wireless application protocols (WAP), radio and microwaves, television and satellites, multimedia computer and multimedia projector in curriculum implementation. In e-learning, curriculum content in the form of texts, visuals, e.g. pictures, posters, videos, audio/sound, multicolor images, maps, and graphics, can be simultaneously presented online to students in both immediate locations (classroom model of e-learning) and various geographical distances (Distance Education model of e-learning).

E-learning in education is the wholesome integration of modern telecommunications equipment and ICT resources, particularly the internet, into the education system. *Tracy (1995)* defines the internet
as the international network of communications in which computers in the Wide Area Network (WAN) talk to each other. **Shavinina (2001)** defines ICT as all the digital technologies, including: computer, scanner, printer, telephone, internet, digital satellite system (DSS), direct broadcast satellite (DBS), pocket-switching, fiber optic cables, laserdisc, microwaves, and multi-media systems for collection, processing, storage and dissemination of information all-over the world. Recent technological advances have made possible individualized learning opportunities that integrate multiple ways of combining such media devices as audio, varied types of visuals, graphics, and sounds. There has been a long history of using visualization to complement textual material. Research findings have generally supported the proposition that human beings remember pictures better than words *(Anglin et al., 2004)*. Human memory is composed of two interdependent types of memory mode to process and store information — the verbal and nonverbal modes. **Paivio (1990)** has indicated that the dual coding of pictures both in its verbal and nonverbal forms is more likely to occur than words, which are more likely to be encoded verbally only. This hypothesis is presented to explain the superior effect of pictures to words when used in instruction.

Animation has been used in various disciplines to deliver instructional material that is hard to present alone using static visuals or that contains content that is highly abstract or invisible to human eyes. Animation, presented as pictures in motion, is analogous to a subset of visual graphics *(Weiss, Knowlton, & Morrison, 2002)*. In a computer-based instructional (CBI) environment, animation is typically used due to its inherent characteristics that facilitate the instructional and learning processes. Animation also has the potential to provide feedback in various forms that may be both entertaining
and motivating to learners striving for the correct response. Different types of questions or questioning strategies can be used to engage learners in deeper cognitive information processing and therefore enhance their learning. King (1992) indicated that having students ask and answer high level questions facilitates their comprehension of the text material by engaging them in tasks such as “focusing attention, organizing the new material, and integrating the new information with existing knowledge”.

1. Concept of Information Technology

Today’s world is a world of information explosion. This information explosion is taking place in such a fast speed that even a literate person is feeling as if he or she is illiterate being not able to cope up with such an information explosion. Here the question arises how is one to cope up with it? The answer is, information technology (IT) that can help in coping with the information explosion. So, we can say that Information Technology is nothing but coping up with explosion of Information. Information technology (IT) is the acquisition, processing, storage and dissemination of vocal, pictorial, textual and numerical information by a micro-electronics - based combination of computing and telecommunication. The term in its modern sense first appeared in a 1958 article published in the Harvard Business Review, in which authors Leavitt and whisler commented that the new technology does not yet have a single established name. we shall call it information technology. It spans a wide variety of areas that include but are not limited to things such as processes, computer software, computer hardware, Programming Languages and data constructs. In short, anything that renders data, information or perceived knowledge in any visual format whatsoever, via any multimedia distribution mechanism, is considered part of the domains space known as Information Technology.
**Meaning of Information Technology (IT):** Information Technology consists of two words Information and Technology. If you know the two words you can understand the word information technology together. The term —Information refers to —any communication or representation of knowledge such as facts, data or opinions in any medium or for, including textual, numerical, graphic Cartographic, narrative or audiovisual forms. —Technology is the practical form of scientific knowledge or the science of application of knowledge to practical. —Information Technology is any equipment or interconnected system or sub system of equipments that is used in the acquisition, storage manipulation, management transmission or reception of data or information.

**Definition of Information Technology:** Information Technology is a scientific, technological and engineering discipline and management technique used in handing the information, it's application and association with social, economical and cultural matters. - UNESCO

Information technology is a systemic study of artifacts that can be used to give form to facts in order to provide meaning for decision making, and artifacts that can be used for organization, processing, communication and application of information - Darnton and Giacoletto.

**1.1 Concept of Communication Technology**

Communication Technology is also comprised of two words like —Communication & Technology. We have already discussed that technology is the science of the application of knowledge to practical purposes. You also know that information means any communication or representation of knowledge in any form. Communication is an integral part of human existence. It is communication that decides the very identity of human beings Modern society is turning into an information society and communication is the exchange of
information. It is the process & transferring information form a sender to a receiver with the use of a medium in which the communication information is understood by both sender and receiver. Communication Technology implies the knowledge, skills and understanding needed to exchange information verbally or non-verbally. It is processing of information interms of accessing information, decoding information and sending it via a medium and changer to the receivers. Medium or channel can be written or oral or gesture form of information through speech, action or any electronic machine. —Communication Technology is the electronic systems used for communication between individuals or groups. It facilitates communication between individuals or groups. Who are not physically present at the same location. Systems such as telephone, telex, Fax, radio, T.V. and Video are included, as well as more recent computer based technologies, including electronic data interchange and e-mail. In short, communication technology is the activity of designing and constructing and maintaining communication systems.

In a knowledge-based economy, educating the workforce tops the agenda of many business and government leaders. Training is considered by many to be one key to American competitiveness and worker success in the global economy. Much of corporate America’s interest in learning stems from a lack of skilled workers.

1.2 Concept Of Educational Technology

Meaning of "Educational Technology" Words are of little interest in themselves but they do indicate changes in thinking. Once the climate of opinion is right, one may arrive at the word "Educational Technology" by different routes. One route starts from audio-visual aids! At first sight, it would appear that teaching machines could go under this heading; but those who work with teaching machines emphasise the importance of programmes rather than machinery.
Hence the heading has to become audio-visual aids and programmed instruction, an odd pairing since some forms of programmed instructions use only the printed page. The new term "educational technology" suggests itself and it may be used to refer to a little beyond the use of equipments and techniques that are associated with equipments. On the other route, starting from programmed instruction, a wider conception of educational technology tends to be reached. It is difficult to keep programmed instruction within narrow bounds. Programmed instruction begins to look as though it is a part of something larger and this is educational or instructional technology. Programmed instruction emphasises that the aims of teaching should be analysed, the methods of accomplishing them made explicit and the effects assessed as precisely as possible. These basic ideas are applicable to the systems of instruction that do not necessarily. The term "technology", as Ofiesh (1964) observes, implies the application of science to art. When we apply the science of learning and communication to teaching, we evolve a technology, i.e., the technology of instruction. In modern education, we can witness the impact of two forces; one, of physical sciences and electronics and the other, of behavioural sciences, operating on the use of teaching machines. Both these forces have contributed to the evolution and growth of educational technology. Fig. 1.1 makes the concept clear.

The interaction of physical sciences with education provides us with traditional aids, tools and hardwares such as paper, ink, books, radios, lingua-phones, films, etc. and more sophisticated modern hardware like electronic computers, space satellites, language laboratories etc.
Fig. 1.1 Evolution and growth of educational technology
1.3 Information and Communication Technology (ICT)

**Definitions**

"ICT stand for information and communication technologies and is defined, as a "diverse set of technological tools and resources used to communicate, and to create, disseminate, store, and manage information."

"ICT implies the technology which consists of electronic devices and associated human interactive materials that enable the user to employ them for a wide range of teaching - learning processes in addition to personal use." These technologies include computers, the Internet, broadcasting technologies (radio and television), and telephony.

"ICT is that technology which uses the information to meet human need or purposes including processing and exchanging."

"Information and communications technology (ICT) in education is the processing of information and its communications facilities and features that variously support teaching, learning and a range of activities in education."

All these definitions combine Communication technology and Information technology that have thin line between them but cannot do away without each other. When these technologies are applied in the field of education, it is termed as ICT in education. The term too can be used as the connotation to the term Educational; technology because it also uses any hardware and software approaches that can enhance yield better learning outcomes. In the era of Computer technology the term ICT mainly focuses on the infrastructure, devices and sources of computer technology and thus it is imperative to discuss about the use of ICT in education by focusing mainly on Computer based technology.
ICTs stand for Information and Communication Technologies and are defined, as a “diverse set of technological tools and resources used to communicate, and to create, disseminate, store, and manage information.” These technologies include computers, the Internet, broadcasting technologies (radio and television), and telephony. *(UNDP, 2000)*.

The term, information and communication technologies (ICT) refers to forms of technologies that are used to create, store, share or transmit, exchange information. This broad definition of ICT includes such technologies as: radio, television, video, DVD, telephone (both fixed line and mobile phones), satellite systems, computer and network hardware and software; as well as the equipment and services associated with these technologies, such as videoconferencing and electronic mail *(UNESCO, 2002)*.

Information and Communication Technologies consist of the hardware, software, networks, and media for collection, storage, processing, transmission and presentation of information (voice, data, text, images), as well as related services. ICTs can be divided into two components, Information and Communication Infrastructure (ICI) which refers to physical telecommunications systems and networks (cellular, broadcast, cable, satellite, postal) and the services that utilize those (Internet, voice, mail, radio, and television), and Information Technology (IT) that refers to the hardware and software of information collection, storage, processing, and presentation. *(WORLD BANK, 2002)*.

Information and communication technology (ICT) has evolved to become a natural part of people’s lives in modern western information societies, where the Internet for instance is used to read newspapers, pay bills, keep in touch with friends and search for information for private and professional purposes. The enormous information flow
available to the public, places high demands on people’s skills in being critical to information and various information sources. Science pervades many contemporary issues, not only in the form of core science, but also frontier science. Hence, ability to evaluate information with a science dimension for instance in terms of: Consistency between claims, reasons and evidence, the sample sizes when researchers are testing new medicines, calculation of risks when building nuclear power plants etc, is important and must be addressed in science education. Furthermore, ICT has in many ways

Information and Communication Technology (ICT) is widely used in education for collection, management, and analysis. ICT in education includes a variety of tools, such as computers, CD-Roms, projection TVs, word processors, image graphic software, email, and Internet-based communication technology. ICT use can influence teaching and learning styles by changing the emphasis from a teacher-centered to a learner-centered style and provides opportunities to improve information-reasoning skills, communication skills, higher thinking skills, creativity, and problem solving (Shaikh & Khoja, 2011; Yusuf & Afolabi, 2010). Become a powerful tool that has revolutionized the work of scientists.

ICT stands for information and Communication Technology comprising three words Information, Communication and Technology. **Information:** Information is resource which has no value until it is extracted, processed and utilized. Information can be defined as data refined into form that is meaningful or valuable to the recipient for drawing conclusions and taking some decisions. **Communication:** Communication is basically the process of sharing thoughts, ideas, feelings, experiences, information, sentiments etc. with others through some mutually agreeable media that is verbal or non-verbal. **Technology:** Technology includes methods and strategies of teaching tools, mechanical and electrical devices and instruments, media equipments, library inventories and even text books.
a. **E-Learning**

Electronic learning or e-learning is a general term used to refer to computer-enhanced learning. It is commonly associated with the field of Advanced Learning Technology (ALT), which deals with both the technologies and associated methodologies in learning using networked and/or multimedia technologies. It is also known as *online learning*. Distance education provided the base for e-learning’s development. E-learning can be "on demand". It overcomes timing, attendance and travel difficulties.

b. **Blended Learning**

Blended Learning is the combination of multiple approaches to learning. It is usually used to define a situation where different delivery methods are combined together to deliver a particular course. These methods may include a mixture of face-to-face classrooms, self-paced learning and online classrooms as shown in Fig. 1.2.

![Fig. 1.2 Blended Learning](image)

i) **Face to Face Learning**

Face to face learning refers to learning that occurs in a traditional classroom setting where a faculty member delivers instruction to a group of learners. This could include lectures, workshops, presentations, tutoring, conference and much more.
ii) Self Paced Learning

Self paced learning provides the flexibility to learn according to the availability of learners’ own time and pace, it occurs in a variety of ways such as: reading specific chapters from text book, studying course material presented through web-based or CD-based course, attending prerecorded classes or sessions, reading articles referred by faculty member, working on assignments & projects, and searching and browsing the internet.

iii) Online Collaborative Learning

Online collaboration involves interaction between learners and faculty members through the web; this interaction can occur in one of the following modes: (1) Synchronous interaction (2) Asynchronous interaction. Synchronous, means "at the same time", it involves interacting with a faculty member and other learners via the Web in real time using technologies such as virtual classrooms and/ or chat rooms. On the other hand, Asynchronous means "not at the same time"; it enables learners to interact with their colleagues and faculty member at their own convenience; such as interacting through email.

c. Distance Learning

It is a type of education, where students work on their own at home or at the office and communicate with faculty and other students via e-mail, electronic forums, videoconferencing, chat rooms, instant messaging and other forms of computer-based communication [6]. It is also known as open learning. Most distance learning programs include a Computer Based Training (CBT) system and communications tools to produce a virtual classroom. Because the Internet and World Wide Web are accessible from virtually all computer platforms, they serve as the foundation for many distance learning systems.
There is realization that the basics goals of science education are not only reading and acquiring the scientific skills but rather it must include communication and higher problem skills as well as information technology as thinking tools that will allow our students to understand the technologies on their footstep and around the world.

**ICT can be used for the following purposes:**

1. To broadcast material, online facility or CD-ROM can be used as sources of information in different subjects;
2. To facilitate communication for pupils with special needs;
3. To use electronic toys to develop spatial awareness and psycho-motor control;
4. To use the Online resource like, email, Chat, discussion forum to support collaborative writing and sharing of information.
5. To facilitate video-conferencing or other form of Tele conferencing to involve wide range of students from distant Geographic areas.
6. For Blended learning by combining conventional classroom learning with E-learning learning systems
7. To process administrative and assessment data.
8. To exchange and share ideas -among teachers for the professional growth.
9. To carry out internet-based research to enhance, educational process.

**Advantages Of The Use Of ICT In Education**

ICT encompasses all those gadgets that deal with the processing of information for better and effective communication. In education, communication process takes place between teachers, students, management and administrative personnel which requires plenty of
data to be stored for retrieval as and when required, to be disseminated or transmitted in the desired format. The hardware and software like OHP, Television, Radio, Computers and related software are used in the educational process. However ICT today is mostly focused on the use of Computer technology for processing the data. In this context, advantages of ICT in education can be listed down as

Quick access to information: Information can be accessed in seconds by connecting to the internet and surfing through Web pages.

Easy availability of updated data: Sitting at home or at any comfortable place the desired information can be accessed easily. This helps the students to learn the updated content. Teachers too can keep themselves abreast of the latest teaching learning strategies and related technologies.

Connecting Geographically dispersed regions: With the advancement of ICT, education does not remain restricted within four walls of the educational institutions. Students from different parts of the world can learn together by using online, offline resources. This would result in the enriching learning experience. Such collaborative learning can result in developing Divergent thinking ability in students, Global perspectives, Respect for varied nature of human life and acculturation and Facilitation of learning.

ICT has contributed in shifting the focus on learning than teaching. ICT helps students to explore knowledge to learn the content through self study. Teacher can help the students by ensuring the right direction towards effective learning. Situational learning, Programmed learning, many Online learning courses are some of the example of self learning strategies that are being utilized with the help of ICT.

Catering to the Individual differences: ICT can contribute in catering to individual needs of the students as per their capabilities and
interest. Crowded class rooms have always been a challenge for the teacher to consider the needs of every student in the class.

**Wider range of communication media:** With the advent of ICT, different means of communication are being introduced in the teaching learning process. Offline learning, on line learning, blended learning are some of the resources that can be used in educational institutions. Collaborative learning, individualized learning strategies can enhance the quality of group as well as individual learning, with the real society. This can ensure the applicability of knowledge.

**Wider learning opportunities for pupils:** Application of latest ICT in education has provided many options to the learners to opt for the course of their choices. Many Online courses are available for them to select any as per their aptitude and interest. Students can evaluate their own progress through different quizzes, ready to use Online tests. This can ensure fulfillment of the employment required in the job market thus minimizing the problem of unemployment. It can also provide more efficient and effective citizens to the society as per the changing needs.

**1.4 Stages of Students’ Involvement with Educational Technology:**

One of the most important issues if we want to understand how students’ learning with educational technology takes place, is to understand the process of students' familiarization with technology. As educators, we also have to be prepared to face the fact that each student has a different adoption rate, as far as computer knowledge is concerned. Teachers have to deal with this issue and to take into consideration not only students' adoption rates in terms of the utilization of technology in the classroom, but also the adoption rate of—important others, in most cases that of their parents, that is, what they consider as an—acceptable way of learning for their children.
Students and parents have to understand that, as latest research has proved, integration of technology into the curriculum can enhance students’ learning (Leask & Pachler, 1999), as —technology activities are a valuable vehicle for all types of learning (Stables, 1997). As also cited in Stables (1997), Kibell, Stables and Green (1996), have found that there are three different formulations regarding educational technology that can be identified as stages of learning with technology: a) awareness of technology, b) competence of technology and c) capability of technology.

**Stage 1: Awareness of Technology: Adoption to Innovation**

The most difficult step in the learning process is this one, as students have to get accustomed to a new way of learning. This is the reason why some scholars say that it is better for children to start with educational technology as a method of learning as early as possible, as they do not know other ways of learning, yet.

Rogers (1995) developed a generalized theory concerning the way that innovation is adopted. He defined innovation as —an idea or object that is perceived as new by an individual or other unit of adoption and that creates uncertainty and resistance in those affected by it (cited in Ndahi, 1999). Cited in the same source, Rogers states that —newness in reference to an innovation does not refer to new knowledge, but to an idea, practice or object about which the person has not yet developed favorite or non-favorite attitudes, not adopted nor rejected. This is a very important part if we consider that students are not predisposed neither in favor nor against educational technology as a teaching method. As a result, this may be an indication that teachers’ attitude towards educational technology and practice may influence students’ attitude too. We assume that attitudes towards the method would also positively affect their learning process. As Rogers (1995) mentions, in order for a new idea to be adopted, certain
characteristics have to be achieved through training: changes in the value system, information and knowledge. These characteristics may affect the rate of adoption (Ndahi, 1999). It is evident, therefore, that teachers influence to a large extent the students’ learning process by the way they present the material in the class, as well as by their own general attitude towards educational technology.

**Stage 2 : Competence of Technology**

With competence of technology we can signify the stage at which students learn how to utilize technological means. One of the most important concepts of the learning process at this stage is what Draper, Brown, et al (1994) have defined as —task grasp, that is the task that actually is regulating a learner's behavior. There are various factors that influence how this —task grasp can be achieved through educational technology. According to Frost & Pierson (1998), —students learn best by beginning with concrete experience and then move progressively to reflection and abstract understanding (p.40). This leads us towards the project-based concept, as it employs this gradual transition of students from simple to more complicated tasks, through real-life experiences. By engaging in projects, students combine learning with practical experience and learning within social context (Stables, 2000). Another factor that influences students' learning is students’ capabilities at a particular age. According to Shield (2000), —the learning task should be tailored to the students' capabilities rather than the students having to fit in the software designer's generalized understanding of how learning should take place (Andaloro & Bellmonte, 1998, as cited in Shield , 2000). This means that in order for the learning process to smoothly lead to the desired learning outcome, teachers should be very helpful when employing texts, reference sources, multimedia and communication tools (Shield, 2000), as they have to adopt them to students' learning capabilities.
**Stage 3: Capabilities of Technology**

At this stage students have learned about technology and its use and they start using it as a mean that facilitates their way towards the desired outcome. This means that at this stage, students as they have initiative for their actions, start finding out the most efficient way to achieve their goals. As cited in Hill & Smith (1998), this is a very important stage as research has shown that moving towards student-centered classrooms can be very effective, as this method of teaching—takes advantage of multiple human abilities (Smith, 1992), recognizes the social basis of learning (Vygotsky, 1978) and values learning in context (Lave, 1988).

**1.5 How Students Learn With Technology**

One of the biggest questions we have in mind when we think about educational technology from the educational point of view, is what is the process involved in order for learning to take place. Schultz (2000), in his study has found a strong relationship between technology and the way of thinking. Characteristically, he mentions that not only the technological progress clearly reflects the way people think at a particular point in time, but also the way people think is clearly mirrored in technology. This is because technology tries to facilitate the process towards the solution of current problems and current problems are the cause for having the process of improving technology initiated. According to Schultz (2000), this interrelationship of technology to human way of thinking also reflects the cognitive abilities of the individuals. Based on the above, we could follow Shield's model (Shield, 2000) in order to explain the process of students learning with educational technology that is schematically represented in Fig. 1.3.
1.6 Factors Affecting and Facilitating ICT Learning

The introduction of information technologies (ITs) in education has been identified strongly with a variety of applications over the years. Computers, internet, educational software, laptops and PDAs are concepts largely used in education as technological icons to show to what extent schools are in line with modern life. However, these technologies are often considered fads but also they show the tip of the iceberg in educational issues. There are many issues that are considered to inter play to determine the extent to which ICT is used. In this unit, the different sides of this iceberg will be analyzed to understand more comprehensively what the factors that affect and facilitate ICT learning are.

i. Teacher-level barriers

Lack of time — for both formal training and self-directed exploration (Fabry & Higgs 1997), and for preparing ICT resources for lessons (Preston et al. 2000) lack of self-confidence in using ICT (Pelgrum 2001)

Negative experiences with ICT in the past (Snoeyink & Ertmer 2001)

Fear of embarrassment in front of pupils and colleagues, loss of status and an effective degrading of professional skills (Russell & Bradley, 1997)
Classroom management difficulties when using ICT, especially where pupil-to-computer ratios are poor (Drenoiyanni & Selwood 1998; Cox et al. 1999)

Lack of the knowledge necessary to enable teachers to resolve technical problems when they occur (VanFossen, 1999)

Lack of personal change management skills (Cox et al. 1999)

Perception that technology does not enhance learning (Yuen & Ma 2002; Preston et al. 2000)

Lack of motivation to change long-standing pedagogical practices (Snoeyink & Ertmer 2001)

Perception of computers as complicated and difficult to use (Cox et al. 1999).

**ii. School-level barriers**

Lack of ICT equipment (Pelgrum 2001; Guha 2000), and the cost of acquiring, using and maintaining ICT resources (Cox et al. 1999)

Lack of access to ICT equipment due to organisational factors such as the deployment of computers in ICT suites rather than classrooms (Fabry & Higgs 1997; Cuban et al. 2001)

Obsolescence of software and hardware (Preston et al. 2000)

Lack of technical support (Preston et al. 2000; Cox et al. 1999)

Lack of administrative support (Albaugh 1997; Butler & Sellbom 2002)

Lack of institutional support through leadership, planning and the involvement of teachers as well as managers in implementing change (Larner & Timberlake 1995; Cox et al. 1999)

Lack of training differentiated according to teachers’ existing ICT skill levels (Veen 1993)
Lack of training focusing on integrating technology in the classroom rather than simply teaching basic skills (VanFossen 1999).

iii. Explanation of findings

This section explores in greater depth the barriers identified in the literature, the reasons behind them, and the relations between them. External and internal barriers Many authors categorise barriers as external (first order) or internal (second order). First-order barriers include lack of equipment, unreliability, lack of technical support and other resource-related issues; second-order barriers include both school-level factors such as organizational culture and teacher-level factors such as beliefs about teaching and technology, and openness to change (Snoeyink & Ertmer 2001). A lack of equipment is the highest rated barrier internationally (Pelgrum 2001), often cited even in well-resourced countries. Indeed, one study (Guha 2000) found that teachers who used technology most were more likely to complain about a lack of equipment. It would appear therefore this is less a barrier to the introduction of technology than to its use in creative and innovative ways. While these first-order barriers are clearly significant, research suggests the importance teachers attach to them can reflect their own second-order barriers (Ertmer et al. 1999). In particular, teachers' beliefs about the relevance of ICT to their subject can magnify or reduce the effect of practical difficulties they may encounter. First-order barriers may even mask second order barriers: perceptions of computers as difficult to use may be as much to do with lack of confidence as with the hardware or software itself (Snoeyink & Ertmer 2001). It is impossible to separate first-order from second-order barriers, or barriers at the teacher level from those at the school or policy level (Mumtaz, 2000).
iv. Attitudes

Attitudes towards ICT, therefore, can be barriers in themselves and can influence or be influenced by other barriers. One study (Fabry & Higgs 1997) divided attitudes into three groups: self-confidence with ICT, perceived relevance of ICT, and innovativeness. Although attitudes partly depend on personality (Guha 2000), the importance of previous computer experience is widely recognised (Snoeyink & Ertmer 2001). Negative experiences affect perceptions of the ease of use and relevance of ICT, reducing confidence and increasing anxiety. Computer anxiety and anxiety about change are key factors limiting teachers' use of technology (Larner & Timberlake 1995). Underlying these anxieties are fear of embarrassment when using computers (Russell & Bradley 1997) and fear of losing professional status through a downgrading of traditional pedagogical skills (Fabry & Higgs 1997).

v. Training:

ICT training can help overcome barriers, yet many authors argue that it often fails to do so. While a lack of time and training are major obstacles (Guha 2000; Cox et al. 1999), research suggests there are weaknesses in the design and delivery of many courses. By focusing on basic ICT skill, training fails to prepare teachers to integrate ICT in their pedagogy (VanFossen 1999; Wild 1996). One study (Snoeyink & Ertmer 2001), on the other hand, found that computer novices preferred to be taught basic skills before addressing pedagogical integration of technology. This illustrates the need for differentiated training, taking into account teachers' varying levels of computer experience and learning styles (Veen 1993). Initial teacher training receives particular attention in the literature. Within institutions offering initial teacher training, access to ICT can be problematic (Murphy & Greenwood 1998), but a perhaps more serious barrier lies in the fact that tutors often have little experience of
using technology to deliver the curriculum (Simpson et al. 1999). As a result, pre-service teachers lack practical models of integration, leading to a disparity between their expectations of ICT use and their actual use (Whetstone & Carr-Chellman 2001). A lack of encouragement to use ICT during teaching practice and varying resources in schools exacerbate this problem (Murphy & Greenwood 1998); for new teachers as much as experienced ones, integration requires both access to ICT in the classroom and the motivation to use it.

1.7 Theories Supporting Use of Information and Communication Technology in Education

Several theories have been the basis for investigating the effect of information and communication technology in the teaching and learning process, Most of the techniques applied to the design and use of CBI and CBL can be traced to one of these theories. Behaviorism, systems theory, and cognitive theory will be discussed in this section with an emphasis on how each provides direction to the design, use, or affect of information and communication technology in education.

i. Behaviorism

Of the theories supporting computer use in education, behaviorism has historically had the greatest influence. Behaviorism was used as the basis for designing early CBI and was also the impetus behind many related teaching strategies, such as the use of teaching machines and programmed texts, Thorndike’s connectionism, Pavlov’s classical conditioning, and Skinner’s operant conditioning steps that guide the developer of instruction including CBI. The three parted instructional development model has some functions, which provide the instructional developer with additional procedures to follow when CBI is designed.
Systems theory, the systems approach, and the instructional development model give considerable guidance to educators interested in designing or evaluating CBI (Dick & Carey, 1990). Preplanning, audience assessment, feedback, interaction between elements of the system (student and lesson) and use of performance-based objectives are techniques that have been derived from systems theory that are routinely used to develop CBI. Systems theory gives educators a proscription for designing effective computer lessons, and although not universally applicable, it does provide considerable direction to educators interested in differentiating between ineffective materials and techniques and those likely to be more successful.

**ii. Cognitive Theory**

Educational psychologists and learning theorists are moving away from the behaviorist approach and have advocated a closer look at the internal processes that occur in learners during instruction. Behavioral psychologists generally ignore the cognitive changes that mentally occur during teaching and maintain that it is impossible to design instruction on changes in a learner’s brain because these changes are not observable, not measurable, and are impossible to predict. On the other hand, cognitive psychologists, a common name for advocates of cognitive theory, attribute a greater degree of autonomy and initiative to the learner (Burner, 1960; Carey, 1986; Hilgard & Bovver, 1975).

Cognitive theory concentrates on the conceptualization of students learning processes. It focuses on the exploration of the way information is received, organized, retained, and used by the brain. Proponents of cognitive theory believe instructional design should take into account the cognitive structure of the learner, and of groups of learners. Several people have been influential in advocating the cognitive approach, including Jerome Bruner, Jean Puget, and Seymour Paper.
Many consider **Bruner (1960)** the primary early advocate of cognitive theory. He has proposed that much of behavior depends on how we structure knowledge about ourselves and the world around us. Cognitive theorists believe instruction must be based on a student's existing state of mental organization, or schema. How knowledge is internally structured or organized by a student has considerable effect on whether new learning will occur. Some have hypothesized that students with a dominant left hemisphere of the brain process information more sequentially and logically than do students who have a dominant right brain hemisphere (*Carey, 1986*). In other words, CBI needs to be organized and delivered in a way that complements the cognitive structure and level of sophistication of the learner. Where behaviorists were concerned with the outcomes of instruction, cognitive scientists are more interested in the content of instruction.

Hypermedia, a computer based instruction approach that is nonlinear and consequential, is a powerful tool being used by cognitive scientists to examine how students interact with instruction during the process of learning. The way students use hypermedia, gives insights into the structure of thinking and how learning occurs.

Burner and other cognitive theorists focus on several concepts (i) how knowledge is organized and structured, (ii) readiness for learning (iii) intuition, by intuitions, Bruner means the intellectual techniques used for arriving at plausible but tentative conclusions without going through a series of analytical steps. In other words, the value of the educated guess is recognized. Last, the importance of motivation, or desire to learn, is identified. Specifically, cognitive scientists accept the importance of students having positive attitudes towards learning.
Cognitive theory gives educators interested in designing or evaluating CBI several guidelines.

1. Predisposition to learning is important. Instruction needs something to get it started, something to keep it going and something to keep it from being random. Bruner (1960) would call this activation, maintenance, and direction.

2. The structure and form of knowledge must be considered. Specifically, the body of material to be learned should be organized in some optimal way. Cognitive theory is partially based on the concept that children are first able to understand concrete operations, then graphic representations, of reality, and finally abstract verbal and numerical symbols. Dale (1946) formalized this concept with his Cone of Experience, which organized experiences in 12 levels of increasing abstraction. Dale stated that before learners can understand abstract experiences they required a sufficient depth and breadth of more realistic experiences they required a sufficient depth and breadth of more realistic experiences.

iii. Constructivism and Situated Cognition

Recently, constructivism and situated cognition have captured the attention of teachers and computer education specialists. Most consider these two models directly related to cognitive theory, but they have interesting implications for the design and use of computer-based instruction. Constructivism is founded on the belief that there is a real world that is experienced but that the person imposes meaning and understanding of the world.

There are many ways to structure the world, and many perspectives of an event or concept. Learners construct their own meaning from
instructional activities. Meaning is rooted in and indexed by experience. Each experience with an idea and the environment of the idea becomes part of the meaning of that idea. The experience in which an idea is embedded is critical to the individuals understanding of an ability to use the idea. Most constructivists believe the experience with concepts and ideas in school are quite different from the experience with those concepts in the real world. Constructivism emphasize situating cognitive experiences in the authentic activities.

Situated cognition, or situated learning, occurs when students work on authentic tasks in a real world setting. It does not occur when students are taught de-contextualized knowledge and skills (Brown, Collins & Duguid, 1989). This implies that effective instruction should be based on authentic tasks that permit the student to construct a learning environment meaningful to them. Students do not discover knowledge; they construct it in authentic settings.

Constructivist and situated cognition principles are causing educators to rethink computer-based learning. First, learner control and use of authentic drawing of a "square" unless they have first experienced "square" shaped thing.

Sequencing of instructional material is important. Cognitive theory is based in part on the idea that there is an optimal sequence for presenting educational experiences. Sequencing must take into account the limited capabilities of learners to process information.

The form and pacing of reinforcement must be considered. Learning depends a great deal on knowledge of results at a time and place when that information can be used. For example, "quadratic equations" should not be taught before "linear equations" structure is learned. Feedback should be directed toward what is appropriate, not what is inappropriate.
Discovery learning is one important technique that incorporates much of cognitive theory. Discovery learning consists of inserting learners into educational situations without telling the student what is already known about that situation. The assumption is that with minimal help from the teacher the student will learn more by discovering the lesson found in the situation. Papert’s (1980) LOGO language is an excellent example of a computer-based tool often used to teach problem solving by discovery learning. Hypermedia is an example of computer-based instruction that gives students the opportunity to explore a lesson in a way that is most appropriate for them.

Information are critical to effectiveness. The lesson must be flexible and rich in content, so students can draw on many stimuli to construct knowledge. Second, use of multimedia that includes visual visuals, graphics, motion segments, visual mnemonics, and sound is important. Computer-based instruction should allow students to receive stimuli from a variety of sources and in many different ways.

Currently, there is more theorizing about constructivism and situated cognition by computer educators than actual application. This almost certainly will change as design models become more sophisticated and as powerful multimedia computers become more widely available.

1.8 Information and Communication Technology (ICT) Approaches

i. Computer Based Learning (CBL)

The term CBL is gaining popularity to describe all students learning related to the computer. Some consider this term more generally because the term learning more naturally encompasses situations where the computer is used as an educational tool but is not delivering information or instructing the students. The term CBL is therefore used as the umbrella term for all educational uses of the computer.
Using CBL approach in the classroom, teachers should be familiar with different roles. **Hannafin and Savenye (1993) and Cheung (1995)** pointed out that when information technology is used in classrooms, teachers act as managers, organizers, coaches, guides, initiators, and facilitators. Thus, CBL is not limited to students, computers and software but can also include and encompass various combinations of the computer with other advanced technologies to create learning experiences for the students.

**ii. Computer Based Instruction (CBI)**

The term computer based instruction is used to describe computer applications in education. CBI is also used frequently but again the term instruction might imply only educational uses of the computer where the computer is delivering information to the student and does not include the tool usages of machine. When this term is used, it refers to use of the computer to deliver information to the student. The following are the characteristics of CBI may be considered: (i) Individualisation: It is an individualized method of teaching. Student should be allowed to work at their own rate. (ii) Learner Control: when teachers direct instructional activities, they control pace and direction. When computers are used to deliver instruction, the focus of control changes. Originally, most CBI allowed the students considerable flexibility in controlling the pace and route of the lesson. (iii) Attitude Changes: It is possible to design CBI so that student’s attitude can be changed both toward the topic being taught and toward the importance of CBI. (iv) Computer Anxiety: A significant proportion of any group of computer users will be considerably more anxious than others in the same group and this anxiety has been shown to be related to problems these people have when they use computers.
iii. Computer Assisted Instruction (CAI)

Computers are a familiar sight in classrooms in the twenty-first century, and technology has been used to streamline many educational tasks. There are different types of educational computer use, and not every use of a computer in the classroom is considered computer-assisted instruction. The educational uses of computers that are considered to be computer-assisted instruction (CAI) or computer-based instruction (CBI) are those cases in which either instruction is presented through a computer program to a passive student, or the computer is the platform for an interactive and personalized learning environment.

Computer-Assisted Instruction (CAI), a program of instructional material presented by means of a computer or computer systems. CAI is defined as an interaction between a student, a computer controlled display and a response entry for the purpose of achieving educational outcomes. CAI is a method of instruction in which there is a purposeful interaction between a learner and computer device the individual learner to achieve the desired instructional objective with his own pace and ability. —Computer-Assisted Instruction (CAI) refers to instruction or remediation presented on a computer. CAI has been developed from the principles of Programmed Instruction.

Within the broad definition, computer-assisted instruction may follow different paths to the same end. One example is how computer-assisted instruction is used in relation to other teaching presentations. CAI can be used either in isolation, bearing the whole responsibility for conveying instruction to students, or in combination with conventional, i.e., face-to-face, teaching methods. In CAI there is interaction between individual student and computer, computer displays instructions and students respond to computer display.
The basic assumptions of CAI are as CAI can be provided simultaneously for as many as 4000 students, CAI is suitable for all types of teaching and learning activities and as the learner’s performance is going to be recorded automatically in computer memory, immediate feedback can be provided to the learners by the teachers and data can be used by the teacher in making the best teaching strategy for the learner in future.

**iv. Computer Assisted Learning (CAL)**

Computer Assisted Learning (CAL) is used to denote the flow of information between the student and computer so as to provide instruction to the student on specific topics. CAL is used to denote a broader function of the computer in mediating the learning environment of the student in different ways. CAI is at times considered to be an aspect of CAL which deals with instruction.

**v. Computer Based Training (CBT)**

Computer-Based Trainings (CBTs) are self-paced learning activities accessible via a computer or handheld device. CBTs typically present content in a linear fashion, much like reading an online book or manual. For this reason they are often used to teach static processes, such as using software or completing mathematical equations. The term Computer-Based Training is often used interchangeably with Web-based training (WBT) with the primary difference being the delivery method. Where CBTs are typically delivered via CD-ROM, WBTs are delivered via the Internet using a web browser. Assessing learning in a CBT usually comes in the form of multiple choice questions, or other assessments that can be easily scored by a computer such as drag-and-drop, radial button, simulation or other interactive means. Assessments are easily scored and recorded via online software, providing immediate end-user feedback and
completion status. Users are often able to print completion records in the form of certificates. CBTs provide learning stimulus beyond traditional learning methodology from textbook, manual, or classroom-based instruction. For example, CBTs offer user-friendly solutions for satisfying continuing education requirements. Instead of limiting students to attending courses or reading printing manuals, students are able to acquire knowledge and skills through methods that are much more conducive to individual learning preferences. For example, CBTs offer visual learning benefits through animation or video, not typically offered by any other means. CBTs can be a good alternative to printed learning materials since rich media, including videos or animations, can easily be embedded to enhance the learning. Another advantage to CBTs is that they can be easily distributed to a wide audience at a relatively low cost once the initial development is completed. However, CBTs pose some learning challenges as well. Typically the creation of effective CBTs requires enormous resources. The software for developing CBTs (such as Flash or Adobe Director) is often more complex than a subject matter expert or teacher is able to use. In addition, the lack of human interaction can limit both the type of content that can be presented as well as the type of assessment that can be performed. Many learning organizations are beginning to use smaller CBT/WBT activities as part of a broader online learning program which may include online discussion or other interactive elements.

**vi. Computer Managed Learning (CML)**

Computer Managed Learning (CML) is used to indicate the use of computer to perform the tedious and time consuming tasks of learning. There are four broad areas in CML in which computer provide management support to the teacher. They are: to construct, score and analyze tests, to keep record of students performance and
progress through courses, to provide guidance to the student advising him on the choice of next course, and to report on the performance and progress of the students to individual students and administrators of the institution.

Basic purpose of CML is to relieve the teacher from his time consuming routine tasks so that he can utilize it for more profitable instructional work.

1.9 Emerging Research Trends In ICT

World over, research in ICT, including ICT in education is being promoted through sponsorship and funding. Some of the newer areas of research are:

i. Educational Technologies for Specific Subject Content:
Researchers are looking at ways in which advances in technology can be put to use to take learners through the complexities of a subject, interacting with them as a tutor would, in order to improve their conceptual understanding of the subject. In the case of subject areas which require experimentation such as science and technology, remote laboratories and virtual experimentations for learning are being promoted. It is assumed that such services will enable online interactive experimentation by access and control of real instruments or simulated situations. Researchers are looking at developing appropriate interfacing techniques for components of ‘plug and play’ type setups of remote and virtual labs. Such user interfaces should be able to overcome the complexities of creation and usability of experiments by learners at different levels.

ii. Enabling faster and economical re-skilling of employees at workplaces: Researchers are trying to find more flexible and faster means of improving employee skills at workplaces that would create a networked learning environment that any person wanting to use could, as and when he needs it. Such efforts are generally aimed at
needs of small and medium sized enterprises in order to help them adapt to innovations and improve their competitiveness.

**iii. Using ICT to foster creativity:** Researchers are looking at ways in which ICT can develop tools which can foster learner's creative potential. This needs the ICT used, to question and develop the thinking potential of the learners, by incorporating components that are challenging, that facilitate questioning and that is able to make the connections between people's responses and their ideas. This will most likely tap the creative potential of the people using the ICT.

**iv. Exploratory Activities:** Some current research studies are aimed at new ways in which ICT can be used for learning. Evaluation of the new methods and their impact on learning forms part of the research. The impact of ICT is expected in areas of adaptation to the new technologies, its penetration in schools and higher level institutions, effectiveness of the tutoring provided by ICT, and the extent of involvement with their work that comes as a result of use of ICT and the emergence of new models of learning.

**v. Technology-enhanced Learning systems which have the capabilities of human tutors:** Researchers are now looking at developing systems that can understand and react appropriately to the learner's abilities and difficulties through user's responses. For example they would look at understanding the response as a result of deep/shallow thinking and reasoning. They would use this information to influence learner's further learning and improve his cognitive skills and develop personalised instructional designs. This needs preparing teachers for the new challenges and researchers are preparing teachers’ toolkits that will attempt to accomplish this. The project hopes to change classroom practice by increasing teachers’ capacity to incorporate technologies into teaching and learning. It will help teachers access online professional learning, analyse, plan and
implement changes in their teaching approaches and access quality online resources. The project is expected to reach the classroom in 2012.

As the technologies develop so too will the expectations from it. Considering the costs involved in implementing an equitable ICT environment for all, and the tight budgets in education, they will be adopted by educationists to the extent that they are able to deliver what they promise to deliver.

1.10. Science Education

Development of science and technology is vital for the progress of any country. It is a major vehicle for enhancing the quality of human life. The developments in science and technology, particularly in information technology and computer science are occurring so fast that it is difficult to portray the world of 2020. The emergence of globalization and the intellectual property rights regime have made ‘knowledge’ a big resource and it is believed that in the 21st century only those countries would excel which possess a wealth of knowledge. Under such a scenario it has become all the more important that we should have a strong science base in our country, particularly in children. A vast infrastructure for education, including science education, has been created in the country. It comprises hundred thousand schools, over 8600 colleges, more than 200 universities, several institutes of specialized learning like Indian Institutes of Technology (IITs), Indian Institute of Science (IISc), Tata Institute of Fundamental Research (TIFR), about 40 scientific laboratories of the Council of Scientific and Industrial Research with an equal number of institutes of Defence Research and Development Organization. All this had a positive impact and we could produce renowned scientists, researchers and academicians. For the education in schools, the Government of India established the National Council
of Educational Research and Training (NCERT) in the early 1960s. It has been the key player in all aspects of science education in schools, including policy formulation and implementation, curriculum development, textbooks production and teachers’ training.

Science teaching at the secondary level can be made more effective with the judicious utilization of multi-media approach involving modern information and communication technologies which are entering the Indian educational system in general and the schools in Jammu region (J&K State) in particular surely but slowly. Technology has played a major role in improving the modern education system at various levels of learning whether it be school, college or university. Not only has the use of technology increased to make the process of teaching and learning in the classroom more effective, learner centered and outcome focused but it has also given an impetus to the teachers to use it as a tool to bridge the gap between traditional learning and modern educational requirements for the overall development of the learner. A look at the use of technology in different settings shows how rapidly various information and communication technologies are being adopted as a catalyst to enhance learning even in Indian School settings which are by and large traditional and slow to innovate. Technology has become the enabler of education in the 21st century and has opened up new vistas in the field of educational research. With the advancement in technology and development of curriculum using ICT-rich material the learner has more flexibility and autonomy to learn at his own pace and time in a highly interactive environment. The present study highlights the impact of technology in education in understanding the learning environments of technology rich science classrooms at the secondary level.

Scientific development in recent decades has, and will continue to have, a significant influence on topics that have great importance for
humanity, quality of life, and peaceful coexistence amongst peoples. Only Scientific developments can respond to the needs of society in order to improve the quality of life of the majority population in our country which lives in poverty. Thus, Science learning has to be seen as necessary for the full realization of a human being. To establish the place of science for all and to meet the challenge of quality science education, all of us are obliged, not simply from an educational perspective, but also from that of ethics and social commitment, to increase efforts to ensure that our younger generation have access to an appropriate scientific and technological culture.

Indian national policy on education and NCERT curriculum guidelines focus on the following objectives for school science education: a) to give emphasis to scientific methodology, the processes rather than the content, b) to provide science which is environment based, locally relevant and meaningful, c) and to encourage an interdisciplinary, integrated view of science (NCERT, 1988; NPE, 1986, 1992). Both the National Policy on Education and the National Curriculum for Elementary and Secondary Education-a Framework state these objectives.

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 aesthetic sensibility (NPE, 1992) and the child should be able to discover and understand the scientific facts, concepts, principles and processes underlying various phenomenon he/she should be able to identify the resources in the locality and use them properly (NCERT, 1988, p.26) and The shift in emphasis from product to the process of science and factual information to interesting, relevant and meaningful scientific knowledge should be the main consideration for content identification and rearrangement (NCERT, 1991).
The curriculum document first sets out the general objectives that the programme hopes to achieve and then outlines the methods, materials and topics that can be used to achieve it. At the outset we clarify that any subject that is studied as science must have certain underlying characteristics with regard to its content and purpose.

- Science involves the observation of the external world through the senses and with instruments that extend the scope of the senses.
- It asks specific questions - qualitative and quantitative - regarding any phenomena observed.
- It attempts to explain these phenomena and establish causal relationships through experimentation.
- It uses the laws so established in developing technology.

It is clear to us that this process necessarily produces only a partial picture of the world, both because of experimental limitations and because social and emotional factors are deliberately ignored in science. This is something to be kept in mind while implementing the curriculum and addressing the issues raised in the classroom. We also feel that it is important to convey to the students that science deals with building a model of the universe, to be modified and reworked if it does not fit. Whereas reality is, models are always provisional.

Objectives: The following list of experiences, skills and abilities can be divided into two parts; a core list that would be expected of all students by the end of eight to nine years of study, and a list of higher order skills that could be recommended for and expected from students who are more inclined to pursue science at a higher level.
**i. Core experiences and skills:**

a. Learning to observe or learning the art of observation. This is probably the most basic skill required and it cuts across all disciplines, whether it is the sciences or the humanities. It is possibly the most difficult one to teach. In operational terms, it would mean paying attention without quick expectation of results to any kind of phenomena.

b. Familiarity with ordinary materials, chemicals, and organisms.

c. Some engagement with ordinary materials, chemicals, and organisms.

d. Some engagement with everyday technology, for example, zippers, bulbs, electronics.

e. Developing skills in drawing, tinkering, carpentry and model-making.

f. Developing skills in handling instruments, equipment, and chemicals.

g. Learning safety procedures.

h. Appropriate writing skills.

i. Collecting and tabulating data by drawing graphs or constructing tables.

j. Appropriate analysis of the data collected. This is often dependent on mathematical ability. Sometimes it requires ingenuity and mathematical sophistication and may involve a conceptual jump.

k. Capacity for questioning, that is, not taking things for granted. This too is a difficult skill to inculcate, as it requires considerable mental alertness and patience. It cannot be taught and can only be exemplified and nurtured.

l. Reasonable knowledge of basic science terminology and history.

m. Looking at science with a sense of perspective.
This is probably much needed now a days. An excessive regard/disregard for science and technology would lead to a lopsided view of things. Any science program ought to bring out the appropriate and inappropriate use - in small and big ways - of scientific knowledge.

**ii. The stage of investigation:** For the ages 10-12, the science programme needs to be tailored to match both growing mathematical skills and widening interest in materials and various natural phenomena. Here other areas of the core experiences and skills, aimed at fostering a closer contact and investigation, are added to the central thread of observation. The difficulty of finding ready-to-use material (since setting up an experimental programme is usually beyond the scope of any one teacher) has fortunately been overcome by locating *The Cambridge Science Cards (Exploring Science and Technology)*, which are tailor-made for this age-group.

Science education is not separate and detachable unit of secondary education. Its growth has to be seen in the context of the part historical events. From 1905 to 1917 there was little improvement in the expansion of science education. Then the first world war intervened which consequently interrupted this expansion considerably expansion in secondary education both in the rural and urban areas after the recommendations of the Calcutta University commission when intermediate colleges in arts, science, medicine and engineering etc., were set up since then, the expenditure on and expansion of secondary education has been on the increase except during the second world war, when the educational system was just kept going on.

Science is one of the areas in which it is essential to check ideas against empirical experience. Children have to check their ideas against what actually happens even though this may not always be
what they would like to have happened the nature of science itself. Then forces pupils who study it into certain patterns of behaviour that can become almost desirable part of their attitudes and habits.

Science education occupies a very eminent place in curriculum both at school and university stages of education in India. It is supposed to perform a two-fold task the prime objective in individualistic perspective is the cultivation of a scientific temper, which includes a spirit of enquiry, a disposition to reason logically and dispassionately a habit of judging beliefs and opinions on available evidence, readiness to reject unfounded theories and principles the courage to admit facts, howsoever, unsettling, recognizing the limits of reasoning power itself. It is also expected of science education that it would give individuals a firm grasp of the concepts and processes of science and impart to them the ability to use the scientific method of problem solving and the techniques of observation and experimentation in handling problem of comprehension or life. It is essential that the emphasis of science education should be on the development of abilities.

Barman (1983) studied the origin and developments of modern science in pre-independent India while Sharma (1984) studied school science from 1947 to 1977. The journey has been from teaching science through the integrated or concept approach, shifting from general science to separate subjects and inclusion of environmental study programmes. These studies have highlighted the various shifts in the development of modern science curricula.

Science education should be urgently addressed to the problem of developing a scientific attitude in the education intensive studies will have to be directed towards those fundamental aspects of science education. What does the scientific attitude consists of precisely? How can it be assessed accurately? Which strategies are most
appropriate to inculcate the spirit of science in students? What steps should be taken to ensure that the attitude of scientific enquiry is applied also to extra scientific domains. Including questions having socio-psychological import? Science education awaits answers to those questions.

“Science based education, incoherence with Indian culture and values can alone provide the foundation and also the instrument for the nation’s progress, security and culture” - Indian Education Commission (1964-66).

The Secondary Education Commission (1953) has recommended that every secondary school pupil should study general science as a compulsory subject. Seminar on the teaching of science in secondary schools held at Tara Devi (Simla) in 1956 dealt with almost all the problems facing the inclusion of General Science as a core subject for the higher secondary classes. One of the recommendations of Kothari Education Commission (1966-69) was that science should be made a compulsory subject in school curriculum. The recommendation was accepted and science was made compulsory in school.

iii. Aims Of Teaching Science

The general aim of science education is to help develop well-defined abilities in cognitive and affective domains, besides enhancing psychomotor skills. It helps to foster an uninhibited spirit of inquiry, characterized by creative, innovative and objective approaches. Educational programmes are designed to help unravel the mysteries of the inter-relationship between science and day-to-day life, health, agriculture, industry, and indeed, the individual and the universe. Scientific wisdom, knowledge and skills are ammunitions that instill confidence and inspire the individuals to challenge existing beliefs, prejudices and practices. They work as a liberating force and serve as a reliable tool in one’s search for truth, harmony and order in different
aspects of life. In Classes I and II *Environmental studies* is wholly devoted to the fundamentals of science. In Classes III to V however, *Environmental studies* branches into two sections: one dealing with science and the other with history and geography that are taught together under the title *Social studies*. The objectives of teaching science at the primary stage are: To learn about flora and fauna, natural resources, the sources of energy and so on, through interaction with the immediate environment; To sharpen observation, inculcate the spirit of exploration; and To develop concern, sensitivity and the ability necessary for the preservation and protection of physical and natural resources. At the upper primary stage, namely Classes VI to VIII, the student is expected to consolidate and strengthen the abilities acquired during the primary stage. The objective is to develop an understanding of the nature of scientific knowledge; certain physical, chemical and biological facts and their relationship to their manifestation in nature and in daily life. The student should be enabled to develop the capacity to use science to help solve problems and arrive at the right decisions. Pupils are also expected to develop the skills required to operate ordinary laboratory/science equipment, and to design simple experiments to seek and find explanations for natural phenomena. At this stage, science education should help the pupil develop an understanding and appreciation of the joint enterprise of science and technology and the inter-relationship of these with other aspects of society.

School education comes to a close with the secondary stage comprising Classes IX and X. The aim of teaching science at this stage is primarily directed towards the learning of key concepts that span all disciplines of science. At the secondary stage, the pupil should be enabled to develop a more profound understanding of the basic nature, structure, principles, processes and methodology of science,
with special reference to its relationship with agriculture, industry and contemporary technology. The teaching of science at this stage should help pupils develop insights in health and environment. Greater emphasis needs to be placed on precision and accuracy while handling laboratory equipment and while engaged in procedures such as quantitative measurement, collection, presentation, analysis of data, and drawing inferences.

**Content Outline**

At the primary stage science is taught under the umbrella of *Environmental studies*. The contents are thematically organized into chapters titled: *Things around plants; Animals and us; Our body and Food, health and weather*. The syllabus concludes with a chapter titled: *Man, science and environment*. Science education imparted to the students at the upper primary stage ought to form part of a smooth and seamless transition from the ‘environmental studies approach’ to a more formal study of science. With this as the guiding principle, efforts have made to formulate content and approach. Accordingly, the organization of concepts in Class VI is somewhat similar to those of the lower primary. In Class VII and VIII, subject matter is dealt with at greater length. Themes like *Science in everyday life; Things around us; Changes around us; Measurement; Separation of substances; The living world; The living body; Air, water and energy; Balance of nature* and *The universe*, make up the course material that engage the students at Class VI. This is followed in Class VII and VIII by more subject oriented themes such as *Mechanics; Heat; Electricity; Magnetism; Carbon and its compounds; Metals and non-metals; Life processes; Evolution*, etc., Interdisciplinary topics like *Health, Nutrition* and *Agriculture* also constitute integral part of the subjects taught at this stage.
Main Problems

Some of the pressing problems facing India with regard to science education can be summarized as follows:

Curriculum load: There is substantial pressure emanating from parents and the general public alike who feel that the school curriculum is excessive and needlessly taxing. It is widely believed the students are stressed out and this has in turn affected their normal all round development. The problem of curriculum load is a complex one and has its roots in many related issues. NCERT is presently revising the national curriculum framework in an effort to resolve this contentious issue.

Preparation of teachers: Pre-services preparation and in-service training of teachers are major problems experienced during implementation of the curriculum. Given the huge number of teachers and geographical character of the country, management of in-service programmers is an intimidating prospect. Efforts are being made to address the problem through direct intervention at the institutional level as well as through distant mode 1 (and through tele-conferencing). A collaborative mechanism is being evolved by agencies like the National Council of Educational Research and Training (NCERT), National Council for Teacher Education (NCTE), Indira Gandhi National Open University (IGNOU), along with State Councils of Educational Research (SCERT) and District Institutes of Education and Training (DIET).

Methods of assessment: The attitude, approach, criteria and yardsticks adopted to assess and evaluate performances in the field of science are woefully inadequate. It in fact is emerging as a major stumbling block in efforts to improve the quality of the education system in India. Unfortunately, queries considered unlikely to rise at examinations are considered irrelevant and ignored by both staff and
students. Methodologies adopted to assess performances are hardly conducive to the development of problem-solving skills among the pupils. To make matters worse, instruction is mainly assessment-driven in the country. Little or no significance is attached to the assessment of practical work, resulting in utter neglect of practical work in school education.

**iv. Recent Reforms**

The latest reforms implemented in India are listed below:

**Improvement of science education in schools:** To improve the quality of science education and to promote scientific temper, a centrally sponsored scheme: ‘Improvement of Science Education in Schools’ has been operational since 1987-88. Under the scheme 100% assistance is provided to the states/union territories (UTs) for provision of science kits to upper primary schools, upgradation of science laboratories and library facilities in senior/secondary schools and training of science teachers. The scheme also provides for assistance to voluntary organizations for undertaking innovative projects in the field of science education.

**v. Environmental Orientation to School Education:**

A centrally sponsored scheme by this name was initiated in 1988-89. The scheme envisages grants to states and union territories for various activities including review and development of curricula of several disciplines at primary, upper primary and secondary levels. The objective is increase awareness about environmental issues. Review of textbooks on ‘environmental studies’ at primary and upper primary levels are undertaken with a view to update and enhance their quality. Strategies for imparting environmental education at upper primary level are worked out. Teaching and learning materials are being developed. Efforts are underway to organize innovative activities with a view to enrich the work experience so the teaching
staff. To achieve these objectives, the scheme also has plans to seek out voluntary agencies for help and assistance.

**vi. Computer literacy and studies in schools:**

The Department of Electronics, in collaboration with the Ministry of Human Resource Development, initiated a pilot project, ‘Computer literacy and studies in schools’ (CLASS) from the school year 1984-85. The project was modified and converted into a centrally sponsored scheme from 1993-94. The aims of the projects are: to provide pupils with an understanding of computers and their use; to provide hands-on experiences; to ‘demystify’ computers to young school goers; to familiarize pupils with a range of computer applications and with the computer’s potential as a controlling and information processing tool.

Meanwhile, the Information Technology Action Plan (1988), which makes significant provisions for integrating computers into the schooling process, has been adopted by the Government. As a consequence, the Ministry of Human Resource Development has launched a new school-computing programme CLASS 2000 from March this year. CLASS 2000 has the following three components viz., Computer literacy in 10,000 schools; Computer-aided learning in 1,000 schools; Computer-based education in 100 Smart Schools will become model centres for others. NCERT developed the Blue Print for Smart Schools upon which the concept of computer-based education would develop. NCERT is committed to providing all possible on-line and off-line support to the above venture.

**vii. Innovative Uses Of Non-School Resources**

In order to promote and popularize science education, several out-of-school activities (using non-school resources) like science exhibitions, science clubs, debates, essay writing and quiz competitions are being organized by the NCERT, the Department of Science & Technology (DST), the National Council of Science Museums (NCSM), the Ministry
of Non-Conventional Energy Sources (MNCES) and many voluntary organizations, such as: Vikram Sarabhai Science Centre, Ahmedabad; Homi Bhabha Centre of Science Education, Mumbai, etc. NCERT has been pioneering exhibitions in India. It has been organizing national level science exhibitions every year since 1971. The national level science exhibition is the culmination of a series of exhibitions organized at school, district, regional and state level every year. At the beginning of the school session every year, NCERT circulates to all states/UTs the main themes and subthemes of the state-level science exhibitions for a particular year. In keeping with the central and state government’s emphasis on improvement of educational facilities in rural areas and for economically weaker sections of the society, the main theme of national and state-level science exhibitions are infused with a distinct bias towards the felt needs of rural India. The social aspect of science and relevance of science and technology for development are some other criteria, which are given due consideration in determining the themes. The NCERT also provides detailed guidelines to the states for organization of exhibitions and outlines the criteria for evaluation of exhibits and the selection of judges. The financial and academic support for the organization of science exhibitions are mainly provided by the NCERT and the state governments concerned. A list of exhibits selected for display at the National level with brief synopsis about each exhibit, a book titled ‘Structure and Working of Science Models’ containing details about some selected exhibits and publicity folders about the science exhibition are published every year by the NCERT. The National Council of Science Museums (NCSM) organizes a number of activities like demonstration lectures, mobile science exhibitions for rural schools, science quiz, science seminars, science fairs, Nature Study and Environment Awareness Programs. NCSM operates and contributes to science education of children at a mass level through
its four museums located at Calcutta, Bangalore, Mumbai and Delhi, besides utilizing a number of regional centres situated in different parts of the country. NCSM has set up 301 school science centres in the states of West Bengal, Assam, Tripura, Manipur, Andhra Pradesh, Karnataka, Madhya Pradesh, Haryana, Punjab and Rajasthan.

viii. NCF-2005 states that good science education is true to the child, true to life and true to science

In the context of NCF-2005 true to child means that the science we teach should be understandable to the child and be able to engage the child in meaningful and joyful learning. True to life means that the science we teach should relate to the environment of the child, prepare her for the world of work and promote in her concerns for life and preservation of the environment. True to science means the science we teach should convey significant aspects of science content at appropriate level and engage the child in learning the processes of acquiring and validating scientific knowledge.

This is just a way of saying what the essential features of a good science curriculum are. The six different validities refer to cognitive, content, process, historical, environmental and ethical aspects of a science curriculum. They should provide base for the teaching learning of science. These validities do not set the limit for the teachers. On the contrary, they provide freedom to the teacher to plan a variety of experiences to seek participation of her students in learning process.

ix. Professional Competencies of science teacher

Many researchers, trainers and associations, currently working on proposing standards for science teachers’ education and profession, have tried to analyse the new role characterising the science teacher by focusing on the involved “competencies”. This concept is considered relevant in all professional fields and particularly in education
research, given the fact that these processes are based on interactions amongst human beings. A definition proposed by **De Ketele (1996)** is the following: “A competence is a set of organized capacities (activities), which act on contents in a given category of situations in order to solve a problem.” In this definition a competence is described as an ability to carry out a specified task or activity to predetermined standards of attainment. According to **De Bueger-Vander Borght C. (1996)**: “competence refers to a state of being well-qualified to perform an activity, task or job function. When a person is competent to do something, he or she has achieved a state of competence that is recognizable and verifiable to a particular community of practitioners. A competency, then, refers to the way that a state of competence can be demonstrated to the relevant community”. In such definitions the notion of competency is confined to the ability to perform a discrete task or “discrete workplace requirement”. The notion that tasks and workplace requirements can be discrete from knowledge, skills, values, attitudes and context is problematic. A parallel evolution of a more complex view of competency from many researchers in the last decade recognises a concept which incorporates “the ability to transfer skills and knowledge to new situations and environments” as well as the performance of tasks expected in the workplace. This “broader” concept can include among others: the performance of tasks, the management of a series of tasks, the ability to respond to irregularities and contingencies, the capacity to deal with the complexities of the workplace including taking responsibility and working with others, the ability to put one’s knowledge, skills and attitudes to new tasks and to new situations, not putting aside respect of others human beings or tolerance of other values. **Pellerey (2001)** has reconstructed the evolution of the competency concept during the last years; now it means not only the mastery of knowledge and methods, or the ability
to manage them, but also the ability to integrate different kinds of knowledge, and to use them synergically. Therefore to be competent in a certain area implies the ability to mobilize one’s own knowledge and to transform it into concrete doing: competency is an individual characteristic and is built (through self-experience and formation) in a given field and in a given area of problems. It includes the content of the learning process as well as the context where it happens and the ability to apply the grasped content (Coggi, 2002). A “competence” has been defined as a collection of resources (knowledge, know-how, knowledge to be) mobilized to solve problems in a particular context.

1.11 Secondary Education

The Secondary Education which serves as a bridge between primary and higher education is expected to prepare young persons between the age group 14-18 in the world of work and entry into higher education. Secondary Education is strongest link between primary education and college education. According to modern concept of education teacher has a high responsibility of proper physical, mental, emotional development of a child. After secondary education some children will enter life, few will go to colleges. Hence teachers of secondary education should have a right attitude to mould child properly to lead his life pleasantly in the society. Development of attitudes in child at secondary level is remarkable. Teacher has to identify and provide opportunity, which will be helpful to the child in future and helpful for national reconstruction. Teacher must have right attitude to impart proper education according to ideas and ideologies of community and nation. If the process of identification and direction is not taken in time, result will be the maladjustment of children, which causes great burden to national development.
1.12 Secondary Education in Goa

Goa is India’s 25th State. The smallest state in India, Goa covers an area of 3,702 km². Situated on the western coast of India, Goa shares its northern boundary with Maharashtra. Karnataka covers the eastern and southern boundary of the state. Panaji is the capital city of the state of Goa In many respects it is one of the best States in India. Before 1961 it was under Portuguese rule. After Liberation, it became a Union Territory and in 1987 it got statehood. Education is the backbone of the State due to the high literacy rate. The main aim of education is to ensure all round development of the people and to make them good citizens of the nation. One of the major tourist destinations in India, Goa also houses some of the best educational institutes of the nation. The scenario of education here is comparatively better than many other states of the nation. According to the 2001 census report, the state has a literacy rate of 82%—well above the national average.

The quality of the state-run schools and low level of corruption has added to the betterment of school education in Goa. There is not much demand for private schools in Goa as people are quite happy with the performance of the government schools at all level. There are approximately 2,153 schools in Goa which includes primary schools, middle schools, secondary schools and higher secondary schools. Most of the schools in Goa are affiliated to the state board of education. However, one can also come across schools affiliated to the CBSE and ICSE board. English is the main medium of instruction at the schools in Goa. Konkani and Portuguese are also taught in several schools of the state. Goa has NCERT & CBSE pattern of education. We find schools imparting education with Konkani, Marathi or English as the medium of instruction.
Directorate Of Education

Goa enjoys a place of pride in the country as one of the most literate states of India. It was liberated from Portuguese rule in 1961 and has registered an impressive progress in the field of education since then. The State has achieved 82% literacy by 2001 and hopes to be 100% literate by 2011.

The Government of Goa considers education as the foundation for human development and a source of cultivation of traits or responsible citizenship. In keeping with the Directive Principles incorporated in the Constitution, it has worked toward the objective of universalisation of education, and has almost achieved its target at the elementary school stage. The growing demand for education at the secondary and higher secondary levels have also been met to a large extent.

In view of the above, the main emphasis in the Tenth Plan period is on:-

Upgradation and qualitative improvement of education.
Orientation of teachers to keep them abreast with modern techniques in the teaching-learning situation.
Vocationalisation of Education / Computer Education.
Strengthening of administrative machinery for effective implementation of policies.

The education system in Goa is effectively streamlined in keeping with the National Policy on Education, 1986 as modified in 1992, to upgrade the quality of education at all levels. The state has already enacted the Compulsory Education Act (1995) and has enforced it from 5-9-1996 to ensure that no child in the age group of 6-14 years remains out of school.
Though the state of Goa has recorded 82.01 per cent literacy and a high attainment level, the need of the hour is to reinforce its educational policy towards bridging regional and gender gaps, reducing the drop-out rate, emphasizing skill development and vocational programmes to curb unemployment, improving quality of education, infrastructure development in schools, orientation of teachers, computer integrated education and upgradation of libraries.

**Organisational Set-up**

The directorate of education deals with the organization, development and regulation of School Education in the State of Goa under the provisions of the Goa, Daman & Diu School Education Act, 1984 and rules made there under. The educational structure of the state consists of pre-primary, primary, middle, secondary and higher secondary education.

**i. Directorate Level** : The headquarters of the Directorate of Education are located at Panaji, Goa. It is headed by Director of Education who is Ex-officio Joint Secretary (Education) and is assisted by Director (Administration), Joint Director of Accounts, three Deputy Directors of Education for Academic, Adult and Vocational Sections, six Assistant Directors of Education, Vocational Education Officer and Environmental Education Officer, all persons holding Class 1 posts.

**ii. District Level** : Goa has two districts viz. North Goa and South Goa. For educational purposes the State has, however, been divided into three educational zones each comprising of three to four talukas/blocks. The headquarters of these zonal offices are (a) at Panaji for the Central Zone covering Tiswadi, Ponda and Sanguem talukas / blocks; (b) at Margao for the South Zone covering Canacona, Quepem, Salcete and Mormugao talukas / blocks; and (c) at Mapusa for the North Zone covering Pernem, Bardez, Bicholim and Sattari
talukas / blocks. Each zonal office is headed by a Deputy Director of Education. He is assisted by an Assistant Director of Education and a Deputy Education Officer who looks after academic matters.

**iii. Taluka / Block Level**: At the block level, three / four Assistant District Educational Inspectors look after the work of administration, supervision, coordination, monitoring, etc. under the supervision and guidance of the Assistant Directors of Education in charge of the respective zones.

### 1.13. Significance of the study

The aspect of science education is very crucial and demands immediate attention for the better development of science teaching and the best delivery of the National Curriculum into practice in the perspectives of classroom situation. The curriculum recommends “science teacher make use of various website related with teaching learning material, methodologies, etc of the subject, which are floated on the internet”. As a matter of facts, knowledge is being transferred by technology with the explosive growth of telecommunication technology and internet (*Knowledge NET, 2000*).

Continuous curriculum review in the light of the contemporary variable indicates that if science education is designed to help industry, commerce, business and higher education in pure and applied disciplines then it should also address its own position and layout that helps to explore more area of research and investigation (*Cockcroft, 1982*). Then the question of how we can help students to construct better experience for themselves should be one of the important aspects of our science teaching. What science is learnt should have a sense in practicability.

One may have a balanced curriculum for learning according to the cognitive levels of the children, emphasizing on the investigational and problem solving skills that ultimately develop critical thinking among
the pupils. Computer Based Instruction (CBI) and Computer Based Learning (CBL) approaches supported with suitable software can be used to make reliance on the notion of “Mathematical Power” – the ultimate goal of the subjects i.e. how? What if? predict, test and hence generalize (Susan, 1992). Therefore an innovative support to teaching of science is a question in the light of present boom of information and communication technology in the country.


Research, evaluation and experimentation in ICT tools and ICT enabled practices in order to inform, guide and critically utilise the potentials of ICT in school education Motivate and enable wider participation of all sections of society in ICT has an ability to transcend the barrier of time and space (Rao, 2010). There has been a dramatic shift from the 1980s to the present day in terms of access to technology by the population in general (Reddy & Sinha, 2009).

National Programme on Technology Enhanced Learning (NPTEL): Launched in Sept., 2006 and funded by MHRD to pave the way between multimedia & web technology to enhance learning of basic science and concepts.

The use of information and communication technology has sharply decreased the value of traditional algorithmic skills taught traditionally and has potentially increased the value of many areas of
scientific knowledge, which rarely found, or even less emphasized in
the school in the previous science curriculum. Thus the question
arises; would the present delivery of science in India be capable of
meeting demand of society? If not, one possible alternate can be to
channelize our teaching of science around ICT, which is now on the
doorstep of our rural and urban students.

Therefore the present study provides an ample opportunity to
determine the effect of varied ICT instructional approaches on
academic achievement and retention in science among secondary
school students of North Goa District in Goa state.