CHAPTER-I
INTRODUCTION

1.0 GENESIS

In the era of globalization, the explosion of technologies is impacting the world in more ways that can be imagined. For example, the way industries and economies are managed have considerably changed. The rapid transmission of data and information has enabled cross-border collaborations to be more efficiently executed, thus allowing businesses to be run more efficiently. Out-sourcing thus become more prevalent and new economies such as those of China and India have prospered as a result. Technology has facilitated and in some cases caused paradigm shift in the way business used to be operated (Friedman, 2006). Creative and critical thinking as well as and problem solving skills are now much more in demand. In the face of changing demands on the type of human resource that should be developed, educators are also emphasizing these new skills in educational curricular reviews. The use of information and communication technologies (ICTs) in education is seen as a way to produce a more educated knowledge-based work force.

The UNESCO World Education Report (1998) notes that the new technologies challenge traditional conceptions both of teaching and learning and by reconfiguring how teachers and learners gain access to knowledge have the potential to transform teaching and learning processes. ICTs provide an array of powerful tools that may help in transforming the present isolated, teacher-centered and text-bound classrooms into rich, student-focused interactive knowledge environments.

ICTs are a diverse set of technological tools and resources used to communicate, and to create, disseminate, store and manage information. Communication and information are at the very heart of the educational process, in formal and non-formal settings, in programmes provided by governmental agencies, public and private educational institutions, profit corporations and non-profit groups, and secular and religious communities.
Much has been written about the use of film, radio, telephones and television in education (cf., Cuban, 1986; De Korte, 1967). Because access to digital tools, applications and networks continues to grow worldwide and media are increasingly available in digital form, ICT-use in education can be expected to increase dramatically. Recent developments in information and communication technologies (ICTs) have opened new challenges for education that 21st century means more than basic reading, writing and computer skills in the context of modern life. “The illiterate of 21st century will not be those who cannot read and write, but those who can not learn, unlearn and relearn.”

In this environment, the need for technologically literate citizens and workers increases every year. Skilled people in the 21st century need to understand how to use technology tools. including computers, networking and other technologies, plus audio, video, and other media and multimedia tools which enable people to perform effectively at work and in their daily lives, using such tools as spread sheets for calculation, budgeting and building scenarios, graphic and multimedia programme for presentations; data bases for research; and networks for communicating with others.

One of the most commonly cited reasons for using ICTs in the classroom has been to better prepare the current generation of students for a workplace where ICTs, particularly computers, the internet and related technologies, are becoming more and more ubiquitous. Technological literacy, or the ability to use ICTs effectively and efficiently, is thus seen as representing a competitive edge in an increasingly globalizing job market.

EnGauge, North Central Regional Educational Laboratory (U.S.) has identified what it calls “21st Century Skills,” which include digital age literacy (consisting of functional literacy, visual literacy, scientific literacy, technological literacy, information literacy, cultural literacy and global awareness), inventive thinking, high order thinking and sound reasoning, effective communication and high productivity. The potential of ICTs to promote the acquisition of these skills is tied to their use as a tool for raising educational equity, including promoting to shift to a learner-centered environment.

Globally, the importance of using ICTs in education, more specifically, e-learning has been well recognized. It has been clearly understood that ICTs have the potential to
add more value and provide effective learning for all, anywhere and anytime with real-time interactivity, which as such is not possible through the conventional face-to-face class room learning. Therefore, children from nations who do not adopt ICTs in education will be left behind and result into serious knowledge divide.

It is perhaps the first and the last opportunity in the current scenario that a technology of potential to enable education for all, anywhere and anytime, has become a reality. The phenomenon of converging the world into a global village is something that has brought in a paradigm shift in the way future economies will develop. It is this very feature that requires nations to adopt ICTs in the day-to-day lives of their people. The sooner it is done, the better it would be for countries to become part of the global information society.

1.1 ICT IN INDIA

“If I were asked under what sky the human mind has most fully developed some of its choicest gifts, has most deeply pondered on the greatest problems of life, and has found solutions, I should point to India.” Max Muller

India recognized the importance of ICT in education especially in 1984-85 when the Computer Literacy And Studies in Schools (CLASS) was initially introduced as a pilot project with the introduction of BBC micro-computers. A total of 12,000 such computers were distributed to secondary and senior secondary schools through State Governments. The project was subsequently adopted as a Centrally Sponsored Scheme during the 8th plan (1993-98) and was widened to provide financial grants to institutions which were given BBC Micros and also to cover new Government Aided Sec./Sr. Sec. Schools. Assistance included annual maintenance grant for BBC micros and purchase as well as maintenance of equipment for new schools.

2598 schools having BBC Micros were covered under the CLASS scheme during the 8th plan for providing instructors, maintenance of hardware, consumables and textbooks for students and training of teachers in schools. In addition, 2371 schools were covered with new hardware and services which included Rs.1.00 lakh for hardware configuration and Rs.1.30 lakhs per annum for recurring costs. Rs.0.80 lakh per annum was kept as the recurring costs for schools which had already been covered under the BBC-Micros scheme.
NIC was identified as the nodal agency for finalizing the contract for the supply of hardware. The use and supply of software was limited, coverage was confined to Sr. Secondary Schools and the students of class XI and XII had to undergo a Computer Course Module.

National Task Force on Information Technology and Software Development (IT Task Force) constituted by the Prime Minister in July, 1998 made specific recommendations on introduction of I.T. in the education sector including schools, such as:

- **Vidyarthi Computer Scheme, Shikshak Computer Scheme and School Computer Scheme** to enable students, teachers or schools respectively, desirous of buying computers to do so under attractive financial packages. These schemes will be supported by a suite of initiatives such as lowering the cost of PCs, easy installment bank loans, computer donations by IT companies and other business houses, bulk donations of computers by NRI organizations, large volume bargain price imports, multi-lateral funding, etc.

- **Computers and internet shall be made accessible to schools, polytechnics, colleges, and public hospitals in the country by the year 2003.**

The concept of SMART schools with emphasis is on Information technology and use of skills and values considered important, in the next millennium, gained momentum to be started on a pilot demonstrative basis in each state, with the provision of Computer Systems to all educational institutions upto Higher Secondary/ Secondary Schools by suitable investments (about 1-3%) of the total budget during the next five years, as per recommendations of the Task Force.

A centrally sponsored scheme “Information and Communication Technology (ICT) in School” was launched, in December 2004, to provide opportunities to secondary state students to develop ICT skills and for ICT -aided learning process as a major catalyst to bridge the digital divide amongst students of various socio-economic and other geographical barriers. The scheme provided support to State/UTs to establish computer Labs on a sustainable basis and aimed at setting up SMART schools in Kendriya Vidyalaya and Navodaya Vidyalayas to act as: “Technology Demonstrators” and to lead in propagating ICT skills among students of neighbourhood schools.
The scheme is currently being implemented both in Government and Government aided secondary and higher schools. Support is provided for procurement of computers and peripherals, educational software, training of teachers, internet connectivity etc.

The financial assistance is given to state and other institutions on the basis of the approvals accorded by Project Monitoring and Evaluation Group (PM & EG) headed by Secretary of the Department of School Education and Literacy, M/HRD. With main emphasis on computer literacy programme, the scheme addresses to act as a learning and teaching aid to make classroom learning more interesting and interactive. The emphasis is also being laid on self-learning aspect through initiatives like Gyan Darshan launched in January, 2000, with three completely digital and round the clock TV channels dedicated to education; Gyan Vani an FM radio channel was launched, In November 2001, with different FM stations in the country (GOI Ministry of HRD Press Release, Oct 21, 2003).

Among other initiatives, mention needs be made of the following key notes:

- Providing access to global information sources was made a priority goal under the National Curriculum Framework for school education released by NCERT in 2000 (NCERT website), besides other stated goals like:
  - The formulation of plans for the integration of computers into the curriculum;
  - The creation of a framework for enhancing learning opportunities using ICTs across the curriculum.

Towards these stated goals, NCERT released PDF copies of all its textbooks from Class I to Class XII on its website in 2006. (NCERT Website).

National council for teacher education (NCTE) took a landmark decision in the year 2000 to make ICT literacy a compulsory part of pre-service teacher education courses, producing and supplying a series of CD ROMS on, ‘IT Literacy’ to all teacher education institution in the country and providing on-campus orientation of teacher educators in the workshop mode and in turn to produce every year over 2, 50, 000 teacher trainees conversant with ICT pedagogy to help improve quality of teacher education and through it the quality of teachers at different levels of schooling. It uploaded all its major publications on its website.
• The Indian Government launched a project called Vidya Vahini in 2002, to provide for IT and IT enabled education in 60,000 schools in India over three years, as a part of Rs. 6,000 crore project. Beginning with a pilot covering 150 schools, the Government proposed to equip each school with a computer lab equipped with internet, intranet and television to facilitate video-conferencing, web-broadcasting and e-learning.

EDUSAT, India’s first dedicated education satellite, launched in September 2004 at a cost of USD 20 million.

• The Government of India, Ministry of HRD, Department of Secondary and Higher Education issued an order on May 20, 2006, for the Broadband connectivity in all the secondary schools during the eleventh five year plan, mooted as ‘National Educational Plan’ by the Prime Minister with an allocation of over 19% of the gross budgetary support for this new thrust area lay emphasis in secondary education, flushing out its mid-term review suggestion to universalize secondary education on lines of the Sarva Shiksha Abhiyan, with a budget permission of Rs. 411 billion to set up ICT labs for computer-aided learning and Edusat Centers for distance learning programmes.

• At the international level, the United Nations too have generated their “Global School and Communities initiative” (GeSci), a special campaign to promote the use of technology in education from their Bangalore base in collaboration with the Indian Ministries of Information Technology and Education, facilitating Policy Support, technical assistance and global resources for the initiative.

• A plethora of Public-Private Partnership (PPP) initiatives State Governments and big private sector organizations and multinationals too have come up to promote computer enabled education to the people in their respective ways such as

• ‘Head Start’ : Computer-Assisted Education in Madhya Pradesh, one of the largest computer enabled education programmes initiated in 2000 by the Rajiv Gandhi Shiksha Mission (RGSM) of Madhya Pradesh Government, essentially aiming at improving the quality of classroom learning through the use of computers in the primary and middle schools. Launched as a pilot project in about 648 schools, it later expanded to over 2,718 rural schools across the state at the elementary level.
• The Intel® Teach Program Launched in February 2000 in India in the cities of Delhi, Bangalore and Mumbai has impacted over one million teachers all over country both in In-service and Pre-service segments within a span of nine years. "With the help of technology, in India) India teachers will be leaders in the transformation of education around the world." – Craig R. Barrett Chairman, Intel Corporation.

Shiksha India (December 2001), a non-profit organization set up by the Confederation of Indian Industries (CII), has created a teacher’s portal using open source tools and technologies (Shiksha India Website).

• Edu Reach (ICT) Educomp, with a record of implementing large scale PPP projects, in partnership with thirteen (13) State Governments, namely, Government of Assam, Karnataka, Orissa, Tripura, Gujarat, Uttar Pradesh, West Bengal, Delhi, Haryana, Jharkhand, Rajasthan, Chattisgarh and Andhra Pradesh covering more than 12000 government schools and benefiting 5.5 million students studying in government schools in India, has as its main objective, to equip each student teacher with technology - based educational skills to make teaching and learning more interactive and interesting.

• An initiative towards the use of ICT in Non-Formal Education includes computer Based Functional Literacy Program (2004) of Tata Consultancy Services in Andhra Pradesh, Tamil Nadu, Madhya Pradesh, Maharashtra, Uttar Pradesh and West Bengal (Tata Literacy Programme Website).

• Hole-in-the Wall training system (2002-2003) developed by NIIT is yet another initiative involving international finance co-operation, a world bank subsidiary which has invested $ 1.6 million for computer kiosks in more than 60 locations to enable underprivileged children in India to learn from web-based curriculum (UNESCO Website).

• With a substantially increased provision for the scheme “Mission in Education through ICT” to Rs.900 crore in the Union Budget for 2009-10, India has the demographic advantage of a large percentage of young population being converted into dynamic economic units enjoying the right to education and ICT skills.
1.2 ROLE OF ICT IN EDUCATION

The progress of any country depends upon the quality of education offered and practices. Indian education was well known for its Gurukul System of Education in the Vedic age. Education in India has undergone various phases and stages of development starting in the Vedic age to the Post-independent period. In all stages of development, there was a concern for bringing in quality education reflecting on the practical aspects in education.

Teaching and learning in the 21st century should be markedly different from earlier times, as to teaching and learning are now occurring in an increasingly online world. Traditionally, learning environments were restricted to face-to-face delivery or where distance education was undertaken, delivery was largely characterized by the posting of printed resources and communication were often slow and cumbersome.

Integrating technology into teaching-learning transaction has been found to transform the teacher’s role from being the traditional ‘Sage on the Stage’ to also being a ‘Guide on the side,’ and students’ roles also change from being passive receivers of content to being more active participants and partners in the learning process (Alley, 1996; Repp, 1996; Roblyer, Edwards and Havriluk, 1997).

ICTs offer great potentials and advantages in enhancing students’ learning as revealed by Lopez (2003), among others. First, information and communication technologies offer a constructivist approach to learning through the provision of interactive learning experiences. Second, learning through ICTs is more effective as they provide opportunities for using multiple technologies (Video, Computer, Telecommunication, etc.), thereby providing visualization aids in the internationalization and understanding of difficult concepts and processes. This gives opportunities for providing links between theory and practice. Third, ICTs provide opportunities for students to gain valuable computer skills which are germane in today’s job market. ICTs also provide students with repertoire of resources to enhance learning. Students have access to current and up-to-minute information; with ease students can revise and update learning resources available to them. The use of ICT in education can improve memory retention, increase motivation and generally deepen understanding (Dede, 1998). Selinger (2004) claimed that ICT can improve the quality of education because
multimedia contents help to illustrate and explain difficult concepts in ways that were previously inaccessible through traditional teaching resources and methodologies.

**Role of ICTs in instruction of specific content areas / skills**

Van Daal *et al.* (2000) demonstrated that Kindergarten children, given a reading and spelling program, dramatically improved their performance, relative to peers not given access to the same program. Similar positive results are reported by Nixon-Ponder (1999).

Becker (2000) conducted a National Survey of teachers and found that teachers report improvement in children’s writing as a result of the use of a computerized programme.

Sadiah (2003) and Sharifah *et al.* (2001) found that students provided with animated mode of lesson presentation using power point not only improved students’ performance but also enhanced their interest in learning biology. Henessy *et al.* (2001) too reported a positive effect of ICT on the students’ interest in biology.

The developed software in Chemistry for standard XI science students was found to be effective in terms of academic achievement of the students. The students and teachers were found to have favourable opinion towards the software package. (Anjali Khir Wadkar, 1999)

Hennessy (2000) reported that the use of computer technology and graphing instruments in a weather project increased student motivation, enjoyment and understanding of graphing technique.

Koetter *et al.* (1990) found through systematic evaluation that, although the use of computers to teach geography concept was feasible, the 5th grades students responded most positively and performed best with live instruction. Yusuf (1994) found that 7th and 8th graders had a significantly deeper understanding of Fundamental geography concepts with computerized instruction than that of the control group.

(Munther Mohammed Zyoud, 1999) found that the 8th standard students were found to have negative attitude towards computer assisted English language instruction. When the computer is used to its full potential, it can help the students achieve more in learning vocabulary, grammar and comprehension to the learners with different IQ, motivation and attitude.
(Indubala U. Singh, 1999) found the developed video-instructional package for the students of IX class significantly effective in imparting knowledge related to environmental education.

Yu (1998) used teaching supported by a personal computer and found improvement of students’ performance and their attitudes to natural sciences. Venezky et al. (2002) reported that technology, especially on the W W W, can be a catalyst for improving and innovating in education, but whereas transformative vision and inspiration-led technology serves only as an additional resource and not as a catalyst.

1.3 ROLE OF ICT IN DISTANCE EDUCATION

Open University network, led by Indira Gandhi National Open University (IGNOU) since its inauguration in 1985, is an ambitious attempt to provide “Education for all”. Most courses of IGNOU use printed text, accompanied by audiotapes, videotapes and other technology. Some courses use teleconferencing, lessons on TV /radio, CDs, web-based content, and interactive radio counseling, and learning centres located throughout India to provide supplementary learning aids and support services.

An educational radio station, Gyan Vani (Voice of Knowledge), opened in India in 2002 using the infrastructure of the Centrally Controlled All India Radio (AIR). Gyan Vani broadcasts to learners of all ages from primary school to university level. It serves a wide range of community needs, using innovative radio formats involving two-way communication. India has over 40 years of experience in using broadcast TV at primary to university levels, including interactive TV programmes using teleconferencing via dedicated educational channels. Stations such as the public Gyan Darshan and the private Zee TV provide round the clock educational broadcasting. Evaluations have indicated a generally positive audience response.

To promote the use of e-learning at IGNOU, telecentres have been created throughout India, equipped with computers and internet connections.
1.4 ROLE OF ICT IN SCHOOL

Speaking about the current state of education almost one hundred years ago, Dewey (2001) noted:

*From the standpoint of the child, the great waste in school comes from his inability to utilize the experience he gets outside...while on the other hand, he is unable to apply in daily life what he is learning in school. This is the isolation of the school – its isolation from life.*

Schools today are in the midst of a great change, of which much can be attributed to technological advances occurring in our world today, including access to an abundance of information, and advances in computers, the internet, communications and networking. Prensky (2001), a New York author coined the term digital native to refer to these new learners born into a world of technology and they think and act differently than students in the past who grew up without technology.

Technology is starting to be seen as the driving force of progress and education is promoted as a means to change from an industrial age to an emerging information age. Schools are under pressure to provide access to the educational technology as quickly as possible (Cuban et al., 2001). School is the nucleus of learning and epicenter for development of any society and nation. The secondary schools in India work in a variety of academic and social contexts. Providing schools with ICTs promises a high return on investment and Information Communication Technology (ICT) is the faster growing field in India. Secondary education is a crucial stage in the educational hierarchy as it prepares the students for higher education and also for the world of work. McFarlane (1999) in a study of the introduction of integrated learning system (ILS) into schools found improved teacher attitudes and use of computers. Technology is most influential when integrated with curriculum and assessment. It can have greatest impact when integrated into curriculum to achieve clear and measurable educational objectives. Integrating of technology with curriculum and professional growth increases students’ achievement. Significant student achievement gains for technology integrated with standards were demonstrated by an eight year longitudinal study of SAT1, performance at New Hampshire’s Brewster Academy. Students participating in the technology integrated school reform effort (School design model) demonstrated average increases of 94 points.
in combined SAT1 performance over students who participated in the traditional independent school experience.

Information and Communication Technologies (ICTs) have had significant impact on the traditional school system. They have provided innovative opportunities for teaching and learning, and they have engendered advances in research about how people learn, thereby bringing about rethinking in the structure of education (Lopez, 2003).

With the liberalization and globalization of Indian economy, the rapid changed witnessed in scientific and technological world and the general need to improve the quality of life and to reduce poverty, it is essential that the school leavers acquire a higher level of knowledge and skills than what they are provided in elementary education. It is also necessary for improvement of vocational knowledge and skills at the senior secondary level to enable some students to be employable.

The presence of computers and internet access raises ICT literacy and skills, better preparing the future generations to participate in the information society. In developing countries, the schools represent ideal access points because they cover large part of the population.

Dimmock (2002) asserts that many of the changes that occurred in education around the globe in the 1990’s “occurred at levels beyond the classroom and the day–to–day experiences of learners”. At the turn of the millennium, he argues for a redefinition of the process and principles of changing school environment, for a more sophisticated understanding is required of the complex interconnections and contexts that constitute school cultures. Learning environments in schools typically involve one or more adult teachers connected with a number of students, usually in well defined physical settings. These people interact and form a variety of relationships, creating what Salomon (1994) calls “a system of interrelated factors that jointly affect learning in interaction with (but separately from) relevant individual and cultural differences” (p, 80) this is what Wubbels, et al. (1991) term the “relationship dimension” in learning environments at school. The learning environment has a physical as well as a relationship dimension. Physically it may be in a room, full of particular furniture and equipment. Curriculum materials such as books and videotapes may also be present. The curriculum also has a place in the relationship dimension of the environment in that the students and teacher(s)
are focused on certain processes and content in the curriculum and have a relationship with that curriculum and the methodologies that are associated with conveying the curriculum. Most experts in the field of educational computing (e.g. Lynch, 1990; Olson, 1988; Rieber, 1994) would characterize computers as interactive and thus admit them a place within the relationship structures of the classroom learning environment, not just the physical environment.

Taylor (1980) framed potential uses of the computer as: (a) tutor, computer assisted instruction in which the computer teaches the child; (b) tool, in which the computer amplifies to address academic tasks; and (c) tutee, in which students learn by programming (tutoring) the computer. There is a general consensus that the use of ICT in teaching and learning brings about positive benefits in student learning. The findings of the impact T2 Survey. (Harrison et al., 2002) provides concrete evidence of ICT having an impact on teaching and learning in the classroom.

Pelgrum (2001) asked practitioners from 26 countries what were the main material and non-material obstacles for ICT implementation. Ten most commonly cited obstacles were: insufficient number of computers, teachers’ lack knowledge/skills, difficult to integrate in instruction, scheduling computer time, insufficient peripherals, not enough copies of software, insufficient teacher time, not enough simultaneous access, not enough supervision staff and lack of technical assistance.

Change in school structure occurred in correspondence with transformations in the social and economic environment within which the school is inscribed and operates. Success in implementing this change requires a certain degree of vision and willingness to ‘learn’ and embrace change, a term coined by Parpert (1993). Nowadays, as ICT has a fundamental impact on our lives, it is only natural to anticipate that the implementation of ICT in school will affect its grammar and lead to fundamental transformations in its structure (Watson, 2001). In the recent years, an increasing number of countries have been endorsing ICT implementation as part of their national education policy, including aspects such as installation of computer infrastructure in schools, connecting computers to the internet, and teacher training (Pelgrum and Anderson, 1999; Venezky and Davis, 2002). Special attention has been given to diffusion of innovative ICT practices as an
ongoing process in several aspects of school life, such as curriculum, teaching and learning processes, timetables and planning of learning space.

Schools around the world perceive integration of ICT into teaching and learning as a challenge, aimed to promote considerable change within the school structure as a whole, or as a lever for local change within one or more of its components, e.g., creation of new learning configurations, formation of novel curricular solutions, broadening and alteration of teachers’ traditional roles, generation of novel educational settings. ICT in schools has educed modification in teachers’ role, from instruction to guidance, assisting students in search of individual learning methods and evaluation of their learning processes and outcomes; and in students’ role, e.g., becoming active learners engaged in collaborative, authentic learning within the community content (Kozma et al., 2003).

In general, an educational innovation can be regarded as a shift in educational paradigm; schools assume the role of being the primary agents for preparing students to function in and became an integral part of the information society (Pelgrum et al. 1997). This paradigm shift is oriented towards lifelong learning; schools’ main goal, accordingly, is to supply skills and competencies required for living and working in a continuously changing world (Fisher, 2000). ICT serves as a driving force behind the design, establishment and evolving of this paradigm shift, affecting both contents (new technology-related concepts and skills included in the curriculum, re-arranging of the curriculum) and general skills (e.g., learning how to learn, acquiring generic knowledge-manipulation skills and teamwork skills). Technology based innovations may facilitate transition from tradition to emerging pedagogical paradigms, leading to novel approaches to instruction in a number of dimensions constituting the school milieu, including the curriculum, time configuration, teacher and student practices and roles, grouping and collaboration (Means et al. 1993). Hence, the people included in the social milieu are of the utmost importance when referring to integrating innovations in schools, the social system refers to the group or groups of people among whom an innovation diffuses within their settings (Rogers, 1995).

Diffusion is the process by which an innovation is communicated through several channels over time, among members of a social system. Rogers provides insight, through
his ‘diffusion of innovation theory’, regarding diffusion patterns of innovative initiatives within schools. He defines this process as containing four components:

a) Diffusion in the process by which an innovation is communicated through several channels over time, among members of a social system
b) The innovation in itself: an idea, practice, or object that is perceived as novel by an individual or a group of individuals;
c) Communication channels: the means by which communication passes from one individual to another; and
d) Time: includes the decision process regarding the innovation, the adoption time by an individual and/or the group, and the adoption rate of the innovation.

1.5 ICT AND TEACHER

According to Fullan (1991), “Educational change depends on what teachers do and think. It is as simple and as complex at that.”

In classrooms today, the role of the teacher needs to change from the traditional role of prescriptor to that of orchestrator of learning – which necessitates the designing of ICT integrated classrooms promoting higher order cognitive skills.

Teachers are rich resources in the implementation of any innovation, for they bring with them rich practical know-hows of the classroom, for example, the Japanese lesson study approach has shown that classroom-based material developed jointly by teachers and external consultants provide resources that can be practically used in the mathematics lessons (Isoda, et al. 2007).

Teaching is becoming one of the most challenging professions in our society where knowledge is expanding rapidly and much of it is available to students as well as teachers at the same time (Perraton et al.2001). As new concepts of learning have evolved, teachers are expected to facilitate learning and make it meaningful to individual learners rather than just to provide knowledge and skills. Modern developments of innovative technologies have provided new possibilities to teaching profession, but at the
same time, have placed more demands on teachers to learn how to use these new technologies in their teaching (Robinson and Latchem, 2003).

ICT has highlighted some significant changes in the teacher’s role:
- Change in relationship with pupils.
- Change in role of facilitators and managers who support learning.
- Change in the content and scope of teaching.
- Changing Locus of control from teachers to learner
- ICT do not meet the task to the attachment or supplement to teachers preparation, but they offer the infinite access to information which is accessible without effort due to internet (Gilmore, 1995).

Although today, access to new technology is provided in most schools (Cuban et al., 2001, p.815), the process of technology integration into every day teaching is still very low, and the full potential of computers and software for mathematics teaching and learning is far from being tapped. Among the various reasons for this phenomenon, NCTM (2000,p 25)expressed probably the most crucial concerns of in principles and standards for school mathematics:

The effective use of technology in the mathematics classroom depends on the teacher. Technology is not a panacea. As with any teaching tool, it can be used well or poorly. Teachers should use technology to enhance their students’ learning opportunities by selecting or creating mathematical tasks that take advantage of what technology can do effectively and well-graphing, visualizing and computing.

Scrimshaw (1997) examined the teacher’s role in classrooms with computers and argued that teachers need to teach the process of learning rather than its products. The conventional learning skills such as locating, collating and summarizing information and identifying connections and contradictions within a body of information, all need to be explicitly moved to the centre of the curriculum. The developments of such skills need to be supported using appropriate forms of software. This requires the explicit teaching of ways of organizing cooperative activities involving computers whether in face-to-face groups around a single machine or through cooperation at a distance via conferencing or email.
Integration of technology in classrooms can significantly transform teaching and learning (Pedretti et al., 1999). New technologies offer new ways of dealing with traditional content in many mathematical areas.

Teachers are the key to whether technology is used appropriately and effectively and technology increases conversation, sharing and learning among students and between students and teachers. Technology Aided Learning (TAL) takes students to higher level of thinking/processing and enables them to become self-learners with the convergence of technologies – the computer, CD-ROMs, video and web-conferencing, internet, broadband and television, to make, it possible for cradle to grave learning to become a reality. The digital world today enables children to learn anything from mathematics to music from teachers across the country and the globe. Numerous results of studies into the impact of ICT on students’ learning have provided convincing evidence of its positive impact on learning gains (cf. Watson, 1993; Liao, Cox and Abbott, 2004) and students’ motivation (cf. Gardner et al., 1993; Cox, 1997).

A digital society requires teachers who are “Digital Literate” Teachers must be multi-skilled in order to manage the multi-skill demands of a curriculum. Information and communication technology as a learning tool has enormous potentials. There is enough scope for learning to dynamically interact and collaborate with content, teachers learning resources to construct their own meaning.

In the present scientific and technological age, the conventional teaching methods are not sufficient to arouse interest among the students nor do they meet up to intellectual, psychological and emotional needs to the students in the new millennium. Traditional methods of imparting knowledge such as lectures, books and conference papers are characterized by a linear progression of information. Human minds are more adaptable than this, using non-linear strategies for problem solving, representation and storage and retrieval of information (For examples, Collins and Quillian, 1969; Collins and LoFlus, 1975). Hypertext software enables teachers to provide them students with the non-linear means to match non-linear thinking processes (Semenov, 2000).

Computer tools can help students or teachers to manipulate complex data sets and help develop mathematical understanding (Cobb and McClain, 2002), visualization tools
can help learners to picture scientific ideas (Jonassen, 2000) or to develop conceptual understanding.

ICT use by pupils and teachers in the case study schools led to positive motivational outcomes, supporting a focus upon learning and tackling of learning tasks (Don Passey et al. 2004). Technology environments allow teachers to adapt their instruction and teaching methods more effectively to their students’ need. By integrating educational tools into their everyday teaching practice, they can provide creative opportunities for supporting Students Learning and Fostering the acquisition of mathematical knowledge and skills.

ICT changes rapidly and new innovations offer new possibilities for teaching and learning these not only open up new technologies to influence the existing curriculum more effectively or more efficiently but change the nature of that curriculum by altering the content of what needs to be taught, such as in the area of digital literacy with use of electronic texts or the progression of how a topic like algebra can best be taught in mathematics.

The teachers who are already regular users of ICT have confidence in using ICT; perceive it to be useful for their personal work and for their teaching and plan to extend their use further in the future. The factors that were found to be most important to teaching were: making the lessons more interesting, easier, more fun for them and their pupils, more motivating for the pupils’ and more enjoyable (Cox et al., 1999). Similarly, those teachers who are motivated and have strong commitments to their pupils learning and their own professional development will evidently integrate computers more easily within their teaching (Moseley et al. 1999) further found that teachers who successfully use technology in the classroom have positive attitudes to ICT and focus on pupil choice and individual study rather than teacher direction. The range of software that is available for subject teachers also encourages some teachers to take ICT (Goodwyn et al., 1997; Scrimshaw, 1997).

New technologies offer new ways of dealing with traditional content in many mathematical areas (Holenwarter, 2006a, p.5).

Whenever technology is used for teaching mathematics, it is the responsibility of the teacher to decide when technology can effectively improve learning opportunities and
which kind of technology is appropriate to reach objectives of the lesson (Lawless and Pellegrino, 2007, p.581). Accordingly “Technology should be used widely and responsibly, with the goal of enriching students’ learning of mathematics” (NCTM, 2000, p.24).

Since technology allows for more student-centered approaches including active learning, mathematical experiments, or discovery learning (Bruner, 1961), usually the role of a teacher needs to transform from being instructor to being a coach or mentor for students.

The level of technology used by the teacher significantly affected student academic achievement in mathematics in a comparison of fourth and fifth grade teachers and their students. Students whose teachers were high level users of technology in the classroom scored significantly better than did students whose teachers were low level users of technology in the classroom. Teachers who were high level of users were differentiated from teachers who were low level users in terms of frequency and extent of use of computers with students, instructional methods used with technology, and perception of influence technology on student learning and behaviour.

The information and knowledge society provokes a continuous change in the role and mission of teachers. Being a teacher in the knowledge society requires new specific competences; a teacher has to deal with new knowledge and new ways of assessing knowledge, a teacher has to deal with a networked world and with new type of cooperation and collaboration, a teacher has to deal with a society in which knowledge plays a crucial role, a teacher has to deal with lifelong learning. The networked knowledge society results in teacher working in a more collaborative way, not only locally in their school, but regionally, nationally and also globally. The teaching profession, therefore, needs to evolve strongly and quickly. Clearly, it appears that teachers are the key agents in the education system and are instrumental in the revolution of education.

1.6 MATHEMATICS IN SOCIETY

At the heart of mathematics is reasoning. One cannot do mathematics without reasoning. . . . Teachers need to provide their students with many opportunities to reason through their solutions, conjectures, and thinking processes. Opportunities in which very
young students... make distinctions between irrelevant and relevant information or attributes, and justify relationships between sets can contribute to their ability to reason logically. -S. Chapin, the Partners in Change Handbook

Mathematical Knowledge, its relevance and importance

In a technological society with complex social needs and structures mathematics plays a crucial role in communication and development. In order to be full members of society all people need to be fluent in mathematics to some degree, and all should have the opportunity to see the power and beauty of mathematics in contributing to richness and fulfillment in their lives (Howson and Kehane, 1990; Black and Atkin, 1996). We focus primarily on mathematics learning and teaching and their development for the wider enhancement of mathematical understanding and its application. We see mathematics to be firmly related to language as a tool for communication, and also as a language in its own right (Pimm, 1987).

In order to exploit fully the power of mathematics in their lives students need a rational or principled understanding of mathematical concepts (Skemp, 1976; Edwards and Mercer, 1987). This means that not only should they develop mathematical skills, know number facts, apply arithmetical procedures correctly, recognize and relate shapes and use statistical formulae, they should perceive the meaning and relatedness of concepts and develop connected understandings that they can apply to problems in their everyday world (Askew et al. 2000). They should be able to draw on mathematics knowledgeably in making informed decisions in life and work. Such principled knowledgeability requires understanding of the nature of mathematics itself in generalization and abstraction (Nardi, 1996).

Importance of Mathematics

- The mathematics of error-correcting codes is applied to CD players and to computers.
- The stunning pictures of far away planets sent by Voyager II could not have had their crispness and quality without such mathematics.
- Voyagers’ journey to the planets could not have been calculated without the mathematics of differential equations.
Whenever it is said that advances are made with supercomputers, there has to be a mathematical theory which instructs the computer what is to be done, so allowing it to apply its capacity for speed and accuracy.

The physical sciences (Chemistry, Physics, Oceanography, and Astronomy) require mathematics for the development of their theories.

In ecology, mathematics is used when studying the laws of population change.

Statistics provides the theory and methodology for the analysis of wide varieties of data.

Statistics is also essential in medicine, for analyzing data on the causes of illness and on the utility of new drugs.

Travel by aeroplane would not be possible without the mathematics of airflow and of control systems.

Body scanners are the expression of subtle mathematics, discovered in the 19th century which makes it possible to construct an image of the inside of an object from information on a number of single X-ray views of it. Thus, mathematics is often said to be involved in matters of life and death.

1.61 Role of ICT in Mathematics Learning

Jean Piaget's (1973) revolutionary finding, “Every normal child is capable of learning mathematics” has put greater responsibility on dispensers of mathematical knowledge and producers of knowledge of mathematics education, which they cannot escape by passing the buck of the poor mathematical ability of the students.

In the present scientific and technological age, since the conventional teaching methods are not sufficient to arouse interest among the students and don not meet up to the intellectual, psychological and emotional needs of the students in the new millennium, the methods of teaching mathematics need to be changed. The integration of technology into teaching and learning of mathematics has also not escaped the attention of educators. As a discipline, mathematics too is very much influenced by the rapid development of Information and Communication Technology (ICT) and mathematics educators have been looking at ways to integrate ICT into the curriculum over the last decade (Becta, 2003). The key benefits of ICT promotes greater collaboration among students and encourages communication and sharing of knowledge. ICT gives rapid and
accurate feedback to students and this contributes towards positive motivation. It also allows them to focus on strategies and interpretations, answers rather than spend time on tedious computational calculations.

Traditionally, mathematics teachers lecture and their students learn by listening. Students develop a narrow set of skills which quickly fade. Research in mathematics education suggests that more than knowledge of content is required to be successful in mathematics. McLeod (1988) suggested that a learner’s ability to master mathematical contents is shaped by the learner’s attitude towards the content. More active approaches to ICT learning show that students can indeed develop deep understanding that does not fade over time. Researchers claim that in comparison to conventional methods of teaching, computer-mediated instruction can enhance a student’s conceptual change in understanding scientific conceptions (Reid et al., 2003; Ronen and Eliahu, 2000). The new technological tools such as computers and computer software have provided educators and students with more opportunities to teach and to learn mathematics in new ways. Yu (1998) used a computer-assisted instruction and found that it increased students’ performance and attitude towards science. Computer animations actively engage students in the learning process. If a picture is worth a thousand words, then pictures that move must be worth a fortune. Most computer animations currently used for mathematics instructions are written in language such as Java, Maple or Mathematic. Cox et al. (2003a) also found that animations and simulations enhanced understanding in mathematics and science and that ICT could create a range of diagrams and other graphical representations of concepts and processes not possible with traditional forms of resources.

Computer tools can help students and teachers manipulate complex datasets. This then provides a context for effective discussion which in turn can help develop mathematical understanding (McClain and Cobb, 2002). ‘Visualisation tools’ can help learners to picture scientific ideas (Jonassen, 2000) or to develop conceptual understanding.

Technology facilitates the students to do numerous computations quickly using calculators. Students are thus enabled to check computations quickly and accurately, thus
allowing them to check and explore the validity of their conjectures (Hennessy, Fung and Scalon, 2001).

Over the last few decades, new technology has become a very important factor in everyday life. Nowadays, computers are vital for business and economy and ‘Computer Literacy’ is considered a very important skill in our society.

Knowing about the increasing importance of new technologies for everyday life, several educational organizations started to develop technology-related standards (Lawless and Pellegrino, 2007), trying to foster the integration of new technology into teaching and learning.

During the last 25 years, computer technology for mathematics classrooms experienced an explosive growth in terms of development as well as availability. This was accompanied by an enormous enthusiasm concerning the potential of new technology for teaching and learning mathematics (Fey et al., 1984). Consequently, substantial money was invested into equipping schools with hardware, software and internet access in order to create an environment that allows technology integration into classrooms (Lawless and Pellegrino, 2007; Cuban et al., 2001).

In mathematics, the key benefits identified from research into ICT use have increased pupil motivation, a more concentrated focus on strategies and interpretation, faster and more accurate feedback to pupils and greater pupil collaboration and cooperation (Becta, 2003d). ICT use made a major contribution to developing problem-solving skills, practicing number skills and exploring patterns and relationships.

Cox et al. (2003a) also found that animations and simulations enhanced understanding in mathematics and science and that ICT could create a range of diagrams and other graphical representations of concepts and processes not possible with traditional forms of resources. They noted that many benefits had been identified regarding the use of LOGO in the late 1990s. These included the development of problem solving skills, transferable skills, higher-order levels of mathematical thinking and the learning of geometric concepts as well as enhanced social interaction through group tasks. Unfortunately, the use of LOGO appears to have diminished as other forms of ICT have been adopted. Concern was also expressed that ICT was used less in mathematics than in many subject areas. This was also noted in ImpaCT2 (Harrison et
al., 2002), where 67 per cent of pupils at KS3 never or hardly ever used ICT in mathematics, although at KS4 the figure was over 80 per cent.

The use of software that enabled pupils to view their designs in 3D was found to enhance the quality of pupils’ work (Ofsted, 2005). Different kinds of technologies and tools have been used for centuries in mathematics, e.g., tools for measurement, calculations and mathematical notion and symbol system. There are cognitive technologies that help the students transcend the limitations of the mind (Pea et al. 1981). Computer software is a special powerful cognitive technology for learning mathematics. This can take the form of an amplifier. Use of tools results in “significantly higher achievement in conceptual areas and their computation and manipulations skills” (McCoy, 1996).

Computer algebra systems, dynamic geometry software and the spreadsheets are the main types of educational software currently used for mathematics teaching and learning. Information can be manipulated easily on a computer so that pupil can make changes and evaluate the effect of those changes. This can be where the information is of the same type such as text in word-processing or numbers in spreadsheets or where it is in different forms such as between tables and text.

A graph plotter is characterised as “generic organiser”. By utilizing the zoom tool in the software specific features of function, graphs might be highlighted. A combination of tools may give the best support for learning, since the different tools can support different phases in the student’s conceptual development. Nakhleh and Krajcik, 1993 suggest gains in students’ abilities to interpret graphs.

ICT is used to promote discussion in small groups and in whole class settings that can help to develop pupils’ thinking and understanding across the curriculum in a variety of subjects and with a range of outcomes. Evidence for this comes from a number of studies involving different curriculum subjects, learners’ mathematical thinking, their individual reasoning, their higher-order thinking through ICT as a subject, conceptual change in science, creativity through Logo programming etc.

Numerous studies document student understanding of mathematics concepts from using computer-based and computer-assisted software. Logo programming, computer-assisted instruction (CAI) microworlds and algebra and geometry software are among
those effective in facilitating mathematics achievement for elementary, middle and high school students when teachers are skilled in guiding student activities.

Students can use simple modeling packages, to gain insight into mathematical functions. Graphic calculators can also be used for this purpose. Modeling and simulation too can be used with special software for geometry and stereometry to give students a greater understanding of figures in two and three dimensional space. Wenglinsky (1998) founds that teaching higher level mathematic concepts to eighth graders (e.g., applications and simulations) has a positive effect on academic achievement. There is evidence of the impact of ICT on practicing skills from a wide range of studies including simple programs with a particular focus such as learning about negative numbers in mathematics (Hativa and Cohen, 1995) or early reading (Mioduser, Tur-Kaspa, and Leitner, 2000) as well as more complex Integrated Learning Systems (ILS) which have all improved pupil attainment. Some researchers have suggested that pupil practice is a crucial factor in any improvement in pupil’s attainment (Van Dusen and Worthen, 1995; Underwood and Brown, 1997). Software can ensure that learners are given tasks at an appropriate level that can be matched at their prior attainment or their individual needs (Lynch, Fawcett and Nicolson, 2000). The National Council of Teachers of Mathematics (NCTM), which is the world’s largest association of mathematics teachers declared technology as one of their six principles for school mathematics. Technology is essential in teaching and learning mathematics; it influences the mathematics that is taught and enhances students’ learning (NCTM, 2000, p.11).

1.7 NEED OF THE STUDY

Technology offers many benefits to enhance education. Most importantly, technology integration has the potential to increase student motivation (Anderson, 2000). Technology empowers students by engaging students in the learning process. The nature of the task shifts from teacher centered to student-centered. Research indicates that challenging and engaging academic tasks that build upon students’ prior knowledge and enable students to construct their own understanding of the content are more apt to enhance student motivation and increase student self-confidence in the cognitive abilities (Brophy, 1983; Meece, 1991; Miller & Meece, 1999). Research also identifies the
benefits of technology integration as the technical aspects to enhance the quality of work, promote access of resources, positively impact student learning, and promote student meta cognitive skills (Heafner & McCoy, 2001; Scheidet, 2003).

Levin (2005) acknowledged that the ways people live, work and communicate are already being changed through ICT. First, the way people live and work is changing. For students today, there is a much greater need for global understanding, for multicultural awareness. So, today’s students no longer want to be passive recipients in the information transfer model of learning. Rather they want to be active participants in the Learning Process. As noted by Driscoll (1994), we no longer can view learners as “empty vessels waiting to be filled, but rather as active organisms seeking meaning.” There is growing recognition that today’s world requires that students be able to work collaboratively with others, think critically and creatively and reflect on their own learning process. ICTs provide powerful tools to support the shift to student-centered learning and new roles of teacher and student. Ittigson and Zewe (2003) cited that technology is essential in teaching and learning mathematics. ICT improves the way mathematics should be taught and enhances student understanding of basic concepts. Many researches have carried out studies to evaluate the benefits of using ICT in mathematics. Becta (2003) summarized the key benefits – ICT promotes greater collaboration among students and encourages communication and sharing of knowledge. ICT gives rapid and accurate feedback to students and this contributes towards positive motivation. It also allows them to focus on strategies and interpretations of answers rather than spend time on tedious computational calculations. ICT also supports constructivist pedagogy, wherein students use technology to explore and reach an understanding of mathematical concepts.

Mathematics remains a difficult and inaccessible subject to most students. This fact is not only accepted globally, but it is, consciously or unconsciously, being passed on from one generation to another. Despite this difficulty, mathematics remains a fundamental requirement for all science and engineering courses. According to Papert (1980), failure of so many students to learn mathematics is largely due to a lack of mathematics culture in adults and the scarcity of adults within mathematics who know how to ‘speak mathematics’.
Because of concerns about low levels of mathematical attainment, new recommendations for classroom practices have emerged over the last decade that aimed at allowing students to understand mathematics concepts, rather than memories facts. This focus on the Learner’s role in mathematics understanding began the development of reforms in mathematics instruction programs that attempted to incorporate new skills of thinking and working in mathematics. Both curriculum and methodology in mathematics classrooms moved from a behaviourist approach using role learning and practices examples towards an interactive problem-solving approach in specific contexts.

In today’s world, teachers need to be equipped not only with subject expertise and effective teaching methodologies but with the capacity to assist students to meet demand of the emerging knowledge based society with new forms of ICT and need to have the ability to use that technology to enhance the quality of learning. The search for ways to integrate technology into mathematics education is influenced by two main factors. First is the explosion of technologies that is influencing all aspects of life and the development of human resource. Knowledge-based workers need to be technologsavvy as well as having critical and creative thinking skills. Second is the mathematics education reform that is now emphasizing the development of mathematical processes. With the emphasis on mathematical process, the scope of the use of technology in the mathematics classroom has, in fact, widened. With technology, tedious computations are easily performed, multiple examples of geometric figures effortlessly produced. Coupled with vivid visuals, technology thus provides an approach of realizing classrooms lessons that encourage mathematics thinking.

The use of technology can, in fact, facilitate the new reform of mathematics, didactics that focus on mathematical processes as it offers quick and accurate computations as well as dynamic visuals as those found in geometry and graphs. This then allows students and teachers more time to concentrate on the mathematical processes in the classroom. Students can develop and demonstrate deeper understanding of mathematical concepts and are able to deal with more advanced mathematical contents than in ‘traditional’ teaching environments.

During the last two decades, researchers have become increasingly aware of the important role teachers play for student achievement, with the implicit assumption that
better teacher performance in terms of mathematical content knowledge, pedagogy and technology integration in combination with knowledge about research outcomes would sufficiently prepare teachers for an easy and effective integration of new technology into their classrooms. Hence, the need for study on effect of ICT on students’ achievement in Mathematics at Secondary level of schooling.

1.8 STATEMENT OF THE STUDY

EFFECT OF INFORMATION AND COMMUNICATION TECHNOLOGY (ICT) ON THE STUDENTS' ACHIEVEMENT IN MATHEMATICS AT SECONDARY LEVEL

1.9 OPERATIONAL DEFINITION OF THE KEY TERMS

A few terms have been frequently used that have got specific meaning for the present investigation. Given below are the operational definitions some of such key terms.

➢ ICT (Information and Communication Technology):

ICT is defined as the term used to describe the tools and processes to access, retrieve, store, organize, manipulate, produce and/or exchange information by electronic and automatic means. These include hardware, software and telecommunication in the form of personal computer, scanners, digital canvass, C.D. and D.V.D. players and programmes like data base system and multi-media applications.

➢ Achievement: Achievement is a measure of knowledge gained by Plan Programme as indicated in the test score.

1.10 OBJECTIVES OF THE STUDY

The present study is designed to realize the following objectives:

1. To develop the Power-Point Programme saved to CD ROM in mathematics for class1X.
2. To validate the Power Point Programme saved to CD ROM.
3. To study the effect of ICT- used teaching on the students' achievement in mathematics.
4. To study the effect of traditional teaching on the students' achievement in mathematics.
5. To study the comparative effect of ICT-used teaching and traditional teaching on the students' achievement in mathematics.
6. To study the effect of ICT used teaching on the students' confidence level in answering the test questions in mathematics.
7. To study the effect of traditional method of teaching on the students' confidence level in answering the test questions in mathematics.
8. To study the comparative effect of ICT-used teaching and traditional method based teaching on the students' confidence level in answering the test questions in mathematics.
9. To study the relationship between students’ achievement and their confidence level in answering the test items on both the groups of students.

1.11 HYPOTHESES

H1. The students’ achievements in mathematics are significantly higher who are taught using ICT than those who are taught using the traditional method of teaching.

H2. The students’ confidence level in answering the test questions in mathematics is significantly higher between those who are taught using ICT than those who are taught using traditional method of teaching.

H3. There is a relation between students' achievements and their confidence level in answering the test items in both the groups of students.

1.12 DELIMITATIONS OF THE STUDY

The present study was confined to:

1. 68 students of class IX
3. Sub-topics: Lateral/ Curved Surface Area, Total Surface Areas, Volumes of different geometrical figures as Cuboids, Cube, Right Circular Cylinder, Right Circular Cone, and Sphere under the main topic "surface areas and volumes".
4. Power Point Programme saved to CD-ROM. The Power Point presentation includes text, animated pictures and video clips with sound.