User Education Programme in academic Libraries

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EMERGING TRENDS IN INFORMATION COMMUNICATION TECHNOLOGY AND THEIR IMPACT ON HIGHER EDUCATION SYSTEM IN INDIA

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The developments in Information Communication Technology (ICT) have revolutionized the higher education scenario of the modern world. In this paper the authors examine the latest developments in the various facets of ICT - personal computers, multimedia, telecommunication technology, computer and communication networks, library and information systems and networks and the services in the of Internet and their role in the higher education system. The emerging trends in higher education both formal and distance education systems caused by the impact of the ICT are also presented in detail.

1 Background

The developments in computer and telecommunication technologies and their application in all the various fields of human life have caused Information Technology (IT) to become the buzz word of the present day. Apart from its vital role in the storage and dissemination of information, IT has already proved its relevance in education, research, economic development, industry, agriculture, medicine, biotechnology and a host of other fields, and this in turn has improved the quality of human life (Sinha and Satpathy, 1998). The impact of IT in the field of education has been quite substantial in the sense that it enables ready access to the world of information and helps in utilizing this information efficiently and effectively, thereby improving the quality as well as productivity of teaching, learning and research.

Recognizing the fact that what India has achieved in the field of IT is only a small proportion of its actual potential, the Government of India have resolved to make the nation a Global IT Super-power, and a 108 point Action Plan aimed at three basic objectives, viz, ‘Info-Infrastructure Drive’, ‘Target ITEX-50’ and ‘IT for All by 2008’ has been formulated. The Government proposes to launch an Operation Knowledge Plan in order to ensure IT for all by 2008. This includes launching of three schemes - Vidhyarthis Computer Scheme, Shikshak Computer Scheme and School Scheme - for schools; making computers and Internet connection available in every school, polytechnic, college, university and public hospital by 2003; and networking of all universities, engineering and medical colleges and other institutions of higher learning in the country. It is also proposed to set up Indian Institutes of Information Technology and to launch specialized courses in association with software industry.

This paper attempts to highlight those facets of IT which have relevance in higher education and research and the nature of
their application. Though the term IT is used to encompass computer and telecommunication technologies, the educational circles prefer to use Information Communication Technology (ICT). The distinction between the two usually made is that IT refers to the hardware, software, networking and logistics, while ICT is more concerned with the ways in which these technologies can enhance the teaching and learning process (Ager, 1998). Hence in this paper also, the authors use the term ICT in the subsequent sections.

2 ICT and higher education

In the present context, ICT forms part of the essential requirements of the infrastructure facilities for both formal and distance education. The working document on higher education in the twenty first century - vision and action, prepared by the Unesco (1998) reiterates that the quality of higher education in future will depend on the attention paid to the development of the new ICT, distance learning and virtual university. Let us examine the facets of ICT and their role in higher education and research.

2.1 Personal computer

The personal computer has a major role in the teaching-learning process in the present context. It has been effectively used as an instructional tool in schools, colleges and universities and also for technical education. The 1970s and 1980s have witnessed a wide spread application of computer assisted learning (CAL) and this has been a topic of serious study and research by educationists. A number of studies comparing the traditional class room instruction with computer aided learning/instruction (CAL/CAI) have been carried out. CAI was found to raise student achievement in examinations from 50th to 60th percentile, meaning that an average student in the CAI section scores a full letter grade better (Narkhede, 1998).

2.2 Multimedia

A multimedia system makes an integrated use of visual data such as images and animation, audio such as speech and music and textual matter. Technology has enabled us to communicate such data through copper wires, optical fibers or as radio or optical waves. They can be received in fixed or mobile terminals, TV screens or notebook PCs (Kaur and Singh, 1998). The developments in software technology have immense potentialities in professional education, especially in technical and management education. Computer aided learning using multimedia has effected drastic changes in the learning pattern of students both at school level and in higher education. Developments in CD-ROM technology and the popularisation of Internet have caused a shift of emphasis from group learning to individualised learning (Power, 1996). The recent developments in multimedia will also result in adaptive computing tutorial systems and will have a major impact on distance education (Narkhede, 1998). A multimedia workstation would be a helpful and interactive device for educating the physically handicapped learners.

In addition to its use as an interactive educational tool, multimedia can serve as a medium for information delivery. It facilitates access to a vast amount of data - textual, graphics and audio. Powerful search facility which enables easy retrieval of the information sought is an added attraction.
2.3 Digital/Electronic/Virtual libraries

Developments in ICT have been instrumental to a transformation in the nature of libraries which function as an essential component of the higher education system. Traditionally, the main function of a library is to collect and organize reading materials and make them available for use. Naturally, the emphasis was on printed materials. But now the situation has changed, as the libraries now acquire or provide access to more and more information in the electronic format - such as online indexes, bibliographic and full text databases etc. The routine operations are also, getting computerized. The term digital library is slightly different from electronic library in the sense that the former deals with information only in the electronic format. It may be in different media such an electronic memory or magnetic or optical discs. It requires multimedia work stations to access information contained within the library or from remote locations via telecommunication networks (Barker, 1997). The most important advantage is that information can be shared instantaneously and easily at a relatively cheap rate. Virtual library on the other hand depends for its existence on a rapidly maturing area of technology, viz virtual reality. Virtual reality has been described as the ultimate multimedia experience - the simplest form of which is known as telepresence. Such experiences depend upon the ability of a computer and its peripherals to create highly realistic situations and surrogates in which users can become totally immersed.

2.4 Library and information systems and networks

Various national and international library and information networks are available to cater to the needs of users/readers for speedy retrieval and dissemination of information. A network implies computer and communication links that permit computers to communicate with each other and to share programs, facilities, data and knowledge bases. A network can be local, i.e., in one room, one office or in one institution or it can be national, regional or international. It is for the electronic transfer of information between two or more points irrespective of distance. Networks have been developed to link industrial plants, banks, schools, offices, railways, airlines, libraries and information centres. These networks provide resources and information to their users in larger volumes at a greater speed than the earlier methods did (Sinha and Satpathy, 1998).

The international networks include the United Nations Information System for Science and Technology (UNISIST), International Information System in Agricultural Sciences and Technology (AGRIS), Population Information Network (POPIN), International Nuclear Information System (INIS) and the Geographic Information System (GIS).

A number of library and information networks have been established in India during the late 1980s and early 1990s. Some of these are very much relevant to higher education and research. For example,

NICNET is a satellite based government information network set up by the National Informatics Centre, Planning Commission, Govt. of India in 1977. Its main objective is to connect the various ministries/ departments of the central government with those of the states and also associated semi-government and autonomous
organizations and it acts as a Government Information System. Now the NICNET has been providing Internet connectivity to the users of academic institutions.

NRDMS, the National Resources Data Management System of the Department of Science & Technology provides computer-oriented resources data management system at the district level. It has a database of different types of natural resources such as forest, land, mineral and environment; socio-economic characteristics like demography, agriculture, industries, infrastructure, etc. and remote sensing data for higher studies and research in science and technology.

NISSAT, the National Information System for Science and Technology, Department of Science & Technology, Govt. of India is an information system that links sectoral information centres for a variety of products including leather technology, food technology, machine tools, drugs, textiles, management studies, chemicals and computer discs and provides factual and numeric information on products, discipline and mission for higher studies and research in respective areas.

ERNET, the Education and Research Network is set up by the Department of Electronics, Govt. of India. It connects a few premier academic institutions like the Indian Institute of Science, Bangalore; all the IITs; Department of Electronics, Delhi; four Indian Institute of Management (IIM's); National Centre for Software Technology (NCST), Bombay and a few Universities for resource sharing and retrieval and dissemination of information to the academicians, researchers, administrators etc.

SIRNET, the scientific and Industrial research Network connects the major National Research Laboratories under the CSIR throughout the country, to facilitate exchange of latest information on developments in science and technology among the scientists of these laboratories. It is working under ERNET which is managed by the INSDOC.

During the 1990s, a number of library networks have been emerged in India linking different libraries and information centres in the metropolitan cities. The first to be developed were Calcutta Library Network (CALIBNET) and the Delhi Library Network (DELNET). These were followed by networks of Bombay (BONET), Madras (MALIBNET), Ahmedabad (ADINET), Pune (PUNENET), Bangalore (BALNET) and Mysore (MYLIBNET). These networks are in the process of creating databases of their holdings and automation of the library activities (Murthy, 1996).

INFLIBNET (Information and Library Network)

The INFLIBNET Programme, was launched by the University Grants Commission in April 1991. It is a cooperative venture aimed at pooling, sharing and optimisation of library resources by the academics in the universities. It will include participants from colleges, universities, R&D laboratories/institutions, information centres and other centres of higher education (Pramod Kumar and Arora, 1996). The headquarters is at Ahmedabad.

INFLIBNET has extended financial support to a total 87 universities during 1997-98 period. It is proposed to extend financial assistance to another set of 18 universities in 1998-99. The INFLIBNET programme has provision for funding for
computerisation of libraries and creation of databases and for training of staff.

Recently the UGC has agreed to provide a 170 node V-SAT network to the universities; and sharing of academic information is to start by 1999 (Pramod Kumar, 1998). The V-SAT along with router, has been successfully installed at the INFLIBNET centre to access Internet through ERNET. This is connected by RF cable to the PES (Personal Earth Station). The router is used as gateway of INFLIBNET.

2.5 The Internet

Various international and national networks have been established for exchange of information. The Internet is a network of networks, the international linking of tens of thousands of business firms, universities and research organizations and millions of individual users. It is a loose network of millions of computers at thousands of sites around the world which communicate to each other through a common language - "the Internet Protocol". It is described as a loose network in the sense that there is no central authority controlling the network. The Internet is accessed by about 160 countries or more and it connects about 50,000 networks bringing 30-40 million people of academic institutions, research groups and other organizations around the world. Any individual with a PC, a modem and STD telephone connection can access Internet. It is the world's largest and fastest growing network which has much to offer. It provides a relatively easy way to communicate and exchange information. In this sense Internet is now considered as the information super highway.

However, as the Internet is continuously increasing both in size and complexity, it is becoming more difficult to use its resources. As a result a number of software tools have been developed to help users navigate the Internet and retrieve its vast treasure of information. As a communication device it allows academicians, researchers, students, faculty members and information scientists to exchange messages and documents each other without being constrained by mail, telegraph or fax. The Internet tools include e-mail, telnet, ftp, archive, gopher, Wide Area Information Service (WAIS) and the most popular World Wide Web (WWW) (Rajashekhar, 1996).

The Internet is one of the most important and complex innovations of mankind. It is a powerful means of dissemination and retrieval of information. The Internet is a network of networks which is one of the powerful / effective tools or technologies ever produced for getting information on fingertips from any part of the world even sitting at one's own location. There are various national, international / global networks systems, more than 40,000, readily accessible through the Internet. As network bandwidths increase it will become common to have video and animation over networks, thereby challenging the conventional analog media such as cable TV and video tapes. Internet has been increasingly used for educational course delivery. MM Pant (1999) gives a rather detailed discussion of the various issues relating to the use of Internet in higher education. Multimedia over the Internet has the potential to embrace all the information technologies ever produced (Narkhede, 1998). Internet would be the largest and most complete learning tool for a group of people with varied educational backgrounds.
and interests. Professors, students, educational administrators, policy makers and other educators can interact and share their ideas instantaneously across the world through Internet. Through Internet, scientists and researchers can have access to the world’s most advanced research facilities and discuss their research problems with others working in the same area / field. Now Net-varsity, a cyberspace equivalence to an open university on the World Wide Web is coming up. Such virtual environment would be very common in the coming future.

Power (1996) observes, conventionally, the transfer of information has been through the media of letters, books, telephone, radio, video, television and computers. These have now been integrated at the electronic frontier to give information highways rather superhighways that facilitate rapid transfer of information on a global scale. Basically, this involves the linking of millions of computers or thousands of computer networks through telephone lines via a device called modem. Technologically it requires a harmonious intermeshing of optic fibres, telecommunication cables and satellites today. This linkage allows the transfer of not only textual data but also sound and visual or graphics.

The information superhighways have revolutionized life in the United States and many western countries bringing workplace to the home and making virtual office and virtual classroom possible. This has been achieved because of the availability of high class technology. During 1990s India has also progressed rapidly in the areas of IT industries and IT products both hardware and software. Reducing the cost of computers and peripherals and making them available at affordable cost has changed the scenario. The computers, fax, e-mail and Internet are being acquired by the various government offices, educational institutions, research institutions, laboratories, colleges and universities for automation as well as for imparting high quality education through multimedia computers in formal and non-formal systems of education in our country now. India is not lagging behind the other countries which have acquired the new IT two or three decades earlier.

Govt. of India has also established the Information Technology Task Force for recommendation and improvement of infrastructural set up for IT applications. The Dept. of Telecommunications is making efforts for providing ISD telephone connections even in villages and towns of remote areas of the country. By the end of the 9th plan or 2002 AD it has been targeted that telephone connection will be provided to the maximum number of consumers.

2.51 Impact of Internet on education

The Internet offers a wealth of information to its users. It is a source of up-to-date information and assistance related to education - technical education, higher education, research in science & technology, social sciences and humanities, advances in medical sciences, engineering, biotechnology, agriculture, management and computer science.

Communication is another critical use that makes the Internet invaluable as a source. Many organizations have set up an INTRANET. This is the network used in the Internet to communicate and share information across the organization. In
universities or other institutions of higher learning. INTRANET can be useful for instant communication among the faculty members, research scholars, students, academicians and administrators within the campus.

Several commercial on-line services are available through Internet, which provide connections to members who pay a monthly connect-time fee. CompuServe America, On-Line, Prodigy, Genie, e-world and several others provide a tremendous range of information and services, including on-line conferencing, electronic mail transfer, program downloading, current weather, access to encyclopedias and other reference works and electronic forum for specific user groups such as expert group in a particular area, organizing teleconferences / seminars etc.

2.6 Telecommunication technology

The merging of telecommunication technology with computer technology which started in 1970s was accelerated in the 1980s with the rapid growth of micro computers and communication softwares. The fall in the cost of computer systems and telecommunication facilities and their enhanced ease of operation brought them within the reach of virtually every branch of education and even to individual teachers and students. This has caused fundamental changes in the social and economic structure of the society also (Bohillier, 1979; Fenessy, 1978). The telecommunication networks enable institutions and individuals to exchange information with high speed and accuracy by electronic means.

The advances and diversification of communication technology and media in recent times have not only increased access to education but have also contributed in the improvement in the quality of education. With the integration of a variety of communication media into the education system, distance education has come to play a major role in universalising higher education. The technological environment of distance education has changed more significantly with the introduction of live interactive media. These media are markedly different from other distance education media, in the sense that they are directed towards group interaction rather than individual interaction. With the explosion of technology, distance education is increasingly being defined not by the technology used for delivery but by the nature of interaction involved in the educational processes (Miller, 1993).

In countries like Canada and the United States the use of interactive communication media, both audio and visual are increasingly being preferred in expanding opportunities for higher education (Rothe, 1985). Further, exclusive education networks, in which current communication technologies are combined with the human resources - subject experts and media specialists - exist in universities and other higher educational institutions. Generally these education networks are the results of collaborative efforts of the universities, technical college system, public broadcasting system, state department of education and telephone companies (Ushadevi, 1997).

In India, such efforts are being taken by the INFLIBNET Centre, Ahmedabad which is also making subject experts / specialists database that can be used for group discussion, interaction and examination.
purposes for postgraduate and doctoral level education. Let us examine some of the specific applications of the telecommunication technology in the field of higher education.

2.61 Electronic mail

An electronic mail or e-mail system is a method for a person to person communication of text messages. It is an example of "store and retrieve" communication technique. Electronic mail system allows two or more subscribers to communicate with each other using electronically transmitted text messages from only standard alphanumeric terminal including PCs for international communication across time barriers. It can also be used for single to multi-point communication (Swaroop Rani, 1992).

As the name implies, electronic mail is a means of correspondence between two or more people using electronic transmission of messages rather than paper and the postal service. In electronic mail, the message is addressed by a sender to a specific individual or group of individuals. The messages can be read, responded to, or copied to others, but each set of messages remains as a discrete communication set. That means, it doesn’t have the powerful and sophisticated message-handling capability of conference. At the same time, e-mail has the advantage of allowing private communication to be controlled or limited to specific individuals. In this sense it provides a means for useful private correspondence.

E-mail is being used by the faculty members, scientists and researchers for their private correspondence and it saves their time in sending and receiving messages at a less cost. It is being used in distance education or open university systems. Now it has become so popular that a visiting card without e-mail address seems to be incomplete.

2.62 Fax

Facsimile transfer of messages, called Fax, is another technology for instant transmission of messages like weather chart, engineering drawings and even hand written notes or letters. It differs qualitatively from other forms of communication. It can transfer copies of any type of documents written in any language and in any script. The copy obtained by the receiver is an exact replica of the original document including signatures. It can transmit a document within two minutes.

A facsimile device scans the sheet of document or printed copy, digitizes the information and transmits it over telephone lines anywhere in the world to a designated receiving machine. At the receiving station, a paper copy of the message is printed as the transmission is received. In offices or institutions, a dedicated phone line and fax machine are installed for this. However, for smaller offices and homes a combined telephone and fax machine can be installed on the same telephone line.

Fax transmission has the advantage of a hard copy at both the originating and receiving ends and the capability to receive the message even though the receiving station may be unattended. This makes Fax a very efficient form of a synchronous communication.

While complete documents can be transmitted by Fax, it is frequently used for messages of 1 to 10 pages. In larger or-
ganizations like educational institutions it is common to find the fax system used for the internal transmission of documents between departments and for communicating with external locations within the country or abroad. The use of fax in education is mainly for administrative, research and scholarly communication purpose. In distance education programme fax may be used for brief communications between teachers and students at a distance.

2.63 Computer conferencing

Computer conferencing is a form of computer-mediated communication in which messages are entered, retrieved and responded to by a group of participants who are registered in a particular subject conference. The messages resemble e-mail, however, computer conferencing differs markedly in the way the messages are managed. A running record of messages is kept for each user so that, when the participant joins the conference, only the unread messages since the last session are presented.

Each participant may read a message, respond to a message or create new messages. Messages may be read chronologically or in a logical reference sequence. The conference is usually convened by a moderator who is responsible for establishing the topics, admitting the participants to confidential or closed conferences and doing whatever is necessary to facilitate discussion among participants.

Conference may be open, closed or confidential. An open conference is one which is listed in the conference index and new participants can self-register. A closed conference is one which is listed in the index, but participation is limited to those admitted by the moderator. This type of conference is one which operates on the system but is not listed and access is gained only through action of the moderator or conference organizer. Such conferences are frequently used for business and administrative purposes.

The majority of available conferencing systems are asynchronous and participants access the system at their own convenience. Messages are entered, stored and retrieved independently of other users who may be on the system simultaneously. The advantage of this asynchronicity is that users are not bound by global time zone limitations, users are able to retrieve and contribute messages during normal working or waking hours and to complete several communication exchanges within one 24-hour day.

The predominance of the synchronous nature of computer conferencing has recently been challenged for educational purposes. In a controlled comparative study of 38 nursing students, superior cognitive quality in the content of conference messages produced by dyads using synchronous mode of communication was found. In both modes students reported satisfaction with computer conferencing as a means of learning.

2.64 File transfer

Distance education applications, which involve computer-based exercises such as word-processed or computational assignments, may use the computer’s file transfer capability to move the material electronically over data transmission lines from the student to the instructor, rather than physical shipment by mail of either hard copy or diskette. The use of the file
transfer enables the student to communicate completed work more quickly over distance than the traditional type of correspondence education that relies on mail services.

The student is able to work off-line on assignments and then through the "upload" capability transmit the completed work in a fraction of time required for on-line composition. Similarly, the instructions and comments from the teachers may be downloaded for use off-line. The file transfer capability reduces substantially the time required for on-line connection and with it the cost associated with a real-time communication link. The computer file transfer emulated documents are more readily exchanged.

2.65 Electronic blackboards

The electronic blackboard or telewriter or audio or audio- graphic display is digitized writing surface, usually used in conjunction with a teleconference system on which the instructor writes at the originating site. The information is displayed on a monitor in each of the receiving sites which are connected via telephone or other telecommunication networks. If a dual system is installed, a receiving site can also serve as an originating point by creating messages on its "blackboard" which are then displayed on the instructors' screen and the screens of other receiving sites.

The use of electronic black board requires two or more communication lines, one for two-way voice communication and one or more for data transmission. The electronic blackboard is a synchronous form of telecommunication incurring transmission costs during the full time.

2.66 Communication satellites

Satellite technology has become one of the most important components of global telecommunication. It has facilitated a dramatic increase in the volume of telecommunication traffic worldwide via, the traditional distribution methods of cable, microwave and broadcast radio and television. Most part of the world can be covered by three strategically located satellites in geostationary orbit 22,300 miles or 36,000 km above the equator (Gross, 1990).

In our country INSAT I and II series of communication satellites make the nationwide classroom programme of UGC and IGNOU possible to reach even the remote areas of India and abroad through international satellites. We can see cricket match, inaugural function of conferences, the telecast of parliamentary news and other regional/national news and other programmes brought by Doordarshan Kendra in every house even in remote areas where TV set is available. Now radio and TV have become the best media of mass communication and a means of non-formal education.

Satellite provides the communication link between originating and receiving locations and devices. Miniaturization of the electronics and reduced costs are making possible the direct home reception of television and radio signals. In other applications, telephone companies may use a satellite connection to jump across continents and oceans and make voice and video communication easier and less costly.

The satellite is contributing to educational provision in two quite distinct ways. On the one hand, its high capacity makes low cost distribution of educational pro-
grammes possible in developing countries like India with large populations. On the other hand, it provides programmes to those areas where sparse population are available at vast distances or where the rugged terrain makes conventional land-based installations impractical.

2.67 Tele-CAI

Computer Assisted Instruction (CAI) enables students within an institutional setting to use computer-based learning materials that are carefully sequenced to achieve instructional objectives and to provide opportunities both for student practice and for immediate feedback on performance. The benefits of good computer-based instruction have been reported as reduced instructional time, increased learner motivation and improved performance (Kulik and Kulik, 1987; Marcoulides, 1990; Sheckley, 1986).

Tele-CAI involves the provision of computer-based materials on a central computer that can be accessed over publicly available data networks. The access unit is usually a personal computer with a modem and communication software at the student’s remote study location.

2.68 Tele-classrooms

The tele-classroom is an integrated assembly of a number of specific communication systems in a co-ordinated teaching/learning environment in which students and instructor are situated in remote locations. The communication facilities are so arranged that all students have access to the same information whether presented by voice, television, or digital display. The transmission of voice and images along the remote site utilizes two or more two-way voice/visual communication channels to allow for the simultaneous exchange of voice/visual messages. As with teleconferencing and traditional classrooms, the tele-classroom provides for synchronous activities and requires the simultaneous presence of all participants. The telecommunication facilities may take one of several forms, depending on local conditions, distance among sites, or legal and economic factors. Direct fibre optic or coaxial cable, point-to-point microwave, and fixed-frequency television or satellite transmission are the options considered in making tele-classroom installations.

A tele-classroom is designed to require the minimum of operating support when it is in use. Automatic system set-up in response to entering a security identification code and password, instructor selected classroom functions, and automatic camera selections are the features which have been designed into these systems to increase ease of use and reliability, and lower the cost of operation.

The educational activities in teleclassroom are similar to those in the traditional classroom, such as lecture with discussion, student enquiry, data and visual display, student discussion/conference, and academic committee meetings.

2.691 Teleconferencing

In the classroom sites, remote for the instructor, a receiver/transmitter is connected to the telephone line, and interconnection of student micro-phones, allowing each student to make comments or ask questions. When the instructor permits it, such comments can be heard at all connected sites.
Teleconferencing is by nature a synchronous form of communication in which all participants must be connected to the network during the same time period. In some applications a second telephone line is used to transmit visual, electronic, blackboard, or graphic images from the instructor to remote sites. In other applications, duplicate sets of visual materials are sent in advance to each site and then displayed locally when called for by the instructor.

2.692 Videotex and databases

Interactive videotex is defined as a user friendly tool that permits to connect low-cost user terminals, based on TV technology, via the standard telephone network to remote computers and that allow the retrieval of information and to perform transactional services (Stynen, 1984).

Videotex systems have been characterised by the ability to present graphic information. This capability ranges from simple, blocky graphics in PRESTEL to the higher resolution of NAPLPS.

3 The emerging face of higher education

Throughout the world, higher education is slowly but definitely undergoing a paradigm shift from an instruction-centred college/university model to a learner-centred integrated network model based on access to learning resources and student initiative (International Council on Distance Education, 1996).

The rate of change is conditioned primarily by socio-economic factors and by the availability of technologies. The new instructional technologies have increased academic productivity, enhanced the quality of traditional teaching and have brought about changes in pedagogy and curriculum content. Due to advancement of IT one can say that technology, in general and ICT in particular have radically altered the procedure of formal education and opened up new avenues or vistas in non-formal and distance education systems.

The ICT has proved to be a boon to the individual faculty members and has greatly increased their efficiency resulting in high productivity in terms of their quality of teaching, application of new ICT in teaching practices etc. They can manage themselves preparing teaching/study materials, research proposals, research reports, manuscripts of research papers and other documents at a less operational cost.

Now-a-days, communication within the University campus and outside has become easy due to local area network (LAN) in campus and that connected to outside by Internet. Now telephone, Fax, e-mail and Internet number are common for each faculty member or department.

3.1 Formal education and classroom teaching

In the case of formal face to face education or classroom teaching, the new ICT provides effective tools that complement conventional teaching practices. Audio-visual aids and multimedia have made classroom teaching more effective and perhaps more interesting. Multimedia packages can be useful in individual learning. Now Computer Aided Learning is becoming an integral part of formal technical/professional education, especially in the area of science and technology, medicine and management studies.
3.11 Individual learning Vs Group learning

Recent advances in ICT result in replacement of group learning by individualised programmed learning. In fact, with the development of information storage devices like CDs or CD-ROM, the availability of multimedia computer at low cost and e-mail / Internet connectivity, the individualised learning is becoming popular in higher education system in our country.

1.2 Curriculum development

CT has also helped in changing the content of course materials/ curricula, basically including information on current advances in the particular subject area. These can be incorporated into the syllabus or curriculum. The regular updating of curriculum would be possible for incorporating the latest information.

3 Research

Research and development is essential for developing nations, for improving the quality of life of people and development of society as a whole. The impact of ICT is immense on research in the areas of basic, fundamental and applied research in science and technology, social sciences, humanities and languages.

The new ICT saves the time of the research scholars and scientists and makes available the latest research findings at the finger tips. Early years researchers had to devote more time in searching the relevant information related to their work from primary, secondary and tertiary sources and get addresses of researchers through current address, and send them a request to send papers. Sometimes it took 3 to 6 months to receive a reprint and sometimes it may not be available. But now the scenario has changed. Through Internet/ e-mail one can get information on desired topics easily or get reprints through e-mail the same day from the scientist/researcher, provided, both sides have the infrastructural facilities. Only thing is that one should know the information or resources available on Internet or should know how to navigate the Internet resources for particular information.

Now various commercial vendors like the Silver Plater, Bowker Saur, OCLC etc. are publishing CD-ROM versions of their publications including, journals, secondary sources, current contents lists and various encyclopedias and reference works. University libraries or libraries attached to other institutions can subscribe to these resources. The databases are available with simple search softwares provided by the companies and they can be run on Windows, DOS or UNIX platforms. A lot of multimedia publications are also common now.

The INFLIBNET Centre has started bibliographic information service for universities and other institutions of higher learning. Through networks or through the Internet one can search the databases and download the information in floppies or get print outs. The major databases available on CD-ROM at INFLIBNET Centre are as follows:-

1. *Dissertation Abstracts : Humanities & Social Sciences*

2. *EconLit: Economic literature - American Economic Association*

3. *EMBASE Drugs & Pharmacology, CD*
4. ERIC: Educational Resources Information Centre

5. IICD: Inside Information CD

6. LISA: Library & Information Science Abstracts

7. NUCSSI: National Union Catalogue of Scientific Serials, India

8. Psyclit: Psychological Literature

9. SSCI: Social Science Citation Index

10. Sociofile: Sociological Abstracts

11. Ulrich's on DISC

By searching the above databases available on CD-ROMs one can get the desired information for research work and can save a lot of time. It will certainly improve the quality of work and output.

In the present Internet era every research worker has access to a gold mine of information treasure and is exposed to a much wider spectrum of ideas and concepts which will make him up-to-date and will check the duplication of works which have already been done at some other place by other scientists or researchers. It makes possible to interact with the people of common interest and with experts in the area to have on-line discussion through teleconferencing or through Internet and may exchange their ideas. The quality of research work will be improved and it will get quick exposure to world community and feedback can be obtained with in a short span of time. One can make his research findings available on Internet for wider circulation. Therefore, it may be concluded that the research works in all fields of knowledge will be faster and of improved quality.

3.4 Distance education

Distance education has been a major beneficiary of the developments in information communication technology. Early innovations of ICT products like audio and video-cassettes facilitated the dissemination of information and the delivery of guidance and instructions. A direct result was the development of the Tele-course model of distance education in the United States. The subsequent introduction of the interactive video-communication systems such as the two-way telephone, interactive television, teleconferencing and the latest on-line discussions on Internet facilitated distance learning for groups at off-campus locations and gave rise to the Distributed Classroom Model (Miller, 1995). Now-a-days, workplace learning is encouraged by universities and business houses, and there are commercial ICT vendors of instructional materials. Universities will have to take note of the fact that they are no longer the sole providers of education, and as the ICDE Project Report observes, colleges and universities in fact, will likely no longer be the principal producer of new knowledge nor chief sources of access to information (International Council of Distance Education, 1996).

The advances in communication technology especially the satellite based teleconferencing, have made it possible to use distance education for training in skills in virtual classroom. The interactive television, as it allows two-way audio and one-way video interaction between the expert and the learners is ideal for distance education. By supplementing teleconferencing with use of facilities in the Internet, distance education mode may have to be used by higher education institutions both to pre-service and inservice education and for educating those who are in service and
want to upgrade their knowledge (Maheswari, 1998).

3.41 Virtual conferencing or Teleconferencing in distance education

It is one of the few interactive modes of distance education which uses television, audio speakers, telephone and fax to promote on-line interaction. It can be either two-way video and audio and one way video. The later type is currently being used in India by the IGNOU for several of its distance higher education programmes and by a few more organizations as well, for conducting meetings and training programmes. Teleconference, apart from increasing access to higher education, is also found to provide an efficient cost-effective forum for meetings and training sessions.

Teleconference uses satellite uplinks from the receiving ends to connect audio and video signals. In the two-way audio and one way video teleconference mode, the panelists sit in a studio and address the participants seated in multiple locations. While the participants from different locations have the benefit of viewing the panelists on the TV monitor set and listening to their address, the panelists on the other hand can only listen to the voices of the participants through telephone and can also receive messages through fax machine simultaneously. Because of its interactive nature teleconference is also referred to as "virtual conference". Virtual conference creates an analogue of communication forms that typically occur in a face-to-face conference including paper presentation, discussion, moderation, question answering etc.

The other live interaction modes include two-way radio, audiographic teleconferencing, Interactive Television system (ITV), computer conference etc. The ITV system uses a three-channel audio and video fibre optic spine connecting electronic classrooms located at different locations just like the regional centres of IGNOU. Computer Conferencing is basically an electronic mail system which locates teaching and learning environment in a computer-mediated communication system. Because of the nature, it is known as "Virtual Classroom" (Ushadevi, 1997).

3.42 Distance education in India

In our country there are two types of distance education systems--correspondence education and open universities. Correspondence education which mainly relies on printed materials has been in existence since two decades back. With the establishment of open universities the scenario has changed because the open universities adopt new information communication technology such as computers, audio-video, telecommunication systems, satellite based country-wide class room programme and multimedia approach. In an open university system students are scattered all over the country or many countries. And they are not required to attend classroom instructions. There may be some face to face interaction at regional study centres during personal contact programmes organized by the university from time to time. Now-a-days the credibility enjoyed by the distance mode of learning is mainly due to adoption of multimedia approach of ICT. Communication media eliminated the problems of distance education and brings education to the doorsteps of the learners.

In our country five open universities have been established, besides other distance education centres of traditional universities. They are:
1. The Indira Gandhi National Open University, New Delhi
2. Nalanda Open University, Bihar
3. Kota Open University, Rajasthan
4. Baba Bhim Rao Ambedkar Open University, Maharashtra
5. Andhra Pradesh Open University, Andhra Pradesh, and
6. Open University, Madhya Pradesh

Besides the print materials supplied to the students, open universities make use of a host of other media and techniques such as the radio broadcast programmes, countrywide television classroom programmes, audio-video cassettes and computer and satellite based audio/video teleconference mode. Computer as a tool is available to improve the process of teaching and learning. Computer provides personalised computer aided learning and instruction and personalised education services to learners. It offers instructions to learners independently as provided through programmed learning for revision of course materials.

Satellite and microwave facilities are being used for distance education/open universities. Telephone is widely used in student counselling by the tutors and coordinators of several open universities throughout the world. Due to the advancement of space/satellite technology, microwave station, telephone facilities, satellite and microwave facilities are available for use. With the launching of INSAT-1A-2B group of satellites most of the remote areas like Andhra Pradesh, Bihar, Gujarat, Maharashtra, Orissa and Uttar Pradesh have been covered under INSAT service from 1993 onwards. UGC has made educational programmes for high schools and undergraduate students which are very popular. The UGC programmes transmitted via INSAT have really created a dynamic countrywide classroom not only for students but also for teachers and educated public from 1984 onwards.

The Indira Gandhi National Open University has started teleconferencing in 1995 in collaboration with Indian Space Research Organisation using the Training and Development Channel (TDC) of INSAT-2B satellite. Teleconferencing is a virtual class room situation where students can interact with faculty of school at New Delhi. Now one way video and two way audio facility through teleconferencing is being provided to 16 regional centres, 3 state open universities and 2 remote study centres.

A study on open university students' use of different media for distance education, revealed that 60% of students preferred video programmes as they bring the students face to face with well known professionals/academicians of the country and brought the inaccessible places within their reach. 30 per cent students give their choice to print materials and 10% for audio programmes. In another set, 80% students got information about IGNOU's telecast through DD and newspapers and magazines, whereas 20% got the information from their respective study centres. 90% students want to see programmes again which they have seen earlier, whereas 10% wanted to concentrate more on print materials. 80% students preferred to see programmes at home whereas 20% like to see the programmes at their respective study centre. The present telecast time is preferred by 90% students. Most of the
respondents desired that the telecast time of IGNOU programme should be increased. Finally, it is concluded that the multimedia approach of IGNOU for imparting distance mode of education appeals to the students at large.

3.5 Virtual Universities

Virtual University is a concept referring to the scenario for the 21st century. A number of models such as the niche and the meta-university concepts have been proposed. The meta university is the one which is intended to provide support for the existing universities in terms of distance education infrastructure, advice, assistance and resource development (Oilo, 1998). Two important seminars, one sponsored by the British Council and IDP Australia, held at Singapore and another at the Melbourne University, both in the second half of 1996, have formulated some models and future scenarios. As per this concept, the traditional university may cease to exist and the ICT centres and libraries will mutate organizationally within each concept, perhaps as virtual libraries on the one hand and local support organisations with specialized assistance on the other (Barker, 1997). The Government of India Action Plan also envisages setting up of virtual institutes in different parts of the country to achieve excellence in distance education.

4 Conclusion

The world of technology is growing at a very rapid rate. It is impossible to measure its impact on the educational spheres due to continuous and growing interaction between learning process and application of technology. In our country also the entry of computer application in every walk of life has been gaining momentum and the higher education is not lagging behind. The impact of ICT on education is tremendous and it has been effectively using in architectural engineering, graphics, computer aided design, in teaching of medical sciences, agricultural biotechnology and distance education/open university systems. It would be a blunder on our part if we fail to adopt the new information technology for teaching-learning process. The new information communication technologies have influenced our way of living and even way of thinking. The ICT would greatly benefit in the area of education and training. In future, it will be possible to link schools and other educational facilities by means of a high-speed, high-band width data communication network in order to instruct and to learn “online” with greater facilities for in-depth learning. In the twenty-first century, the use of digital multimedia computers, telecommunication networks, and the Internet will considerably enhance the users’ efficiency, productivity and knowledge base by providing the capability to access, retrieve, use and exchange information from a variety of national and international databases available on Internet and in CD-ROMs.

We are now at the gate of next millennium and we have to prepare ourselves according to the new technological advancement in order to face the challenges of the information era. We have seen that all these ICTs are being tremendously used in the developed countries. Government of India has been giving preferences to IT and for quick infrastructural development. Information Technology Task Force has been established to give recommendations for its implementation. We hope that the next millennium would be bright for higher
education system and India will emerge as a leader of software / hardware developments and computer literate manpower in the 21st century.

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