
UNIT 1 INTRODUCTION TO EDUCATIONAL TECHNOLOGY

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1.1 INTRODUCTION

You may be aware of the use of different technologies such as radio, television, computer, etc., in educational processes. In fact, all these technologies have transformed the educational processes. Earlier, technologies like radio, audio-video programmes, television, etc. were understood as educational technologies. But with the advancement in information technology and communication technologies, there has been a transition from educational technology to information and communication technology (ICT). Newer digital technologies such as computers,

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mobile and the Internet constitute Information and Communication Technologies, They have been visualized as powerful teaching- learning tools for optimizing learning outcomes of learners. Different ICTs have potentiality to expand the access to education, strengthen the process of education and enhance the quality of education. Of late, there have been several new developments in ICT, which have significant implications for educational practices. The present Unit is an attempt to give you an understanding of the concepts of educational technology and information and communication technologies (ICT), how educational technology has transitioned to ICT, recent trends in technology use in education, and issues and concerns in the use of technology in education.

1.2 OBJECTIVES

After going through the unit, you should be able to:

- explain the concept of ‘educational technology’;
- differentiate between technology in education and technology of education;
- describe the transition of Educational Technology to Information and Communication Technology;
- explain the meaning and nature of ICT;
- explain the meaning of free and open source movement in education;
- describe the current trends in use of technology in education;
- discuss miniaturization of technology; and
- discuss the issues and concerns in the use of ICT.

1.3 CONCEPT OF EDUCATIONAL TECHNOLOGY

You, as a practitioner in education, must be using technology in your classroom teaching or training sessions to make your presentations more effective. But to most people, the term ‘educational technology’ is associated only with the equipment or the hardware part, which they use such as overhead projector, television, computers, etc. But the concept of educational technology should not to be confused with the electronic gadgetry; it has a wider meaning as wide as education itself. By this it means that educational technology is concerned with the design and evaluation of the curriculum and learning experiences to be provided and also with the problems of implementing it.

Let us understand the meaning of the term ‘educational technology’ by splitting it into education and technology, Technology, as we understand, refers to the systematic application of techniques and principles to achieve an objective. Technology results in new designs and devices to improve human productivity. Education is the process of acquiring and imparting knowledge crucial to the development of a learner, Therefore, it can be concluded that the educational technology would be the application of techniques and principles of education to improve human learning.

There have been a number of definitions of educational technology which have been provided over the years; let us go through them to get the better understanding of the term 'Educational Technology'.

“Educational Technology is the development, application and evaluation of systems, techniques and aids to improve human learning.” (National Council for Educational Technology for the United Kingdom” (NCET, 1967)

Another definition by National Center for Programmed Learning, has put the term of Educational Technology as “Educational Technology is the application of the scientific knowledge about learning, and conditions of learning, to improve the effectiveness and efficiency of teaching and training. In the absence of the scientifically established principles, educational technology implements techniques of empirical testing to improve learning situation”.

Derik Unwin (1969) has also defined educational technology as 'the application of modern skills and techniques to the requirements of education and training.'

G.O.M. Leith (1975) defined “educational technology” as “an application of scientific knowledge about learning and conditions of learning to improve the effectiveness and efficiency of teaching and learning”.

According to UNESCO, “Educational technology is a communication resulting from the application of the scientific methods to the behavioral science of teaching and learning. This communication may or may not require the use of media such as television broadcasts, radio, cassettes, etc.”

The main components of this communication process as given by UNESCO are as follows:

- a) Goals or the behavioral objectives,
- b) Analysis of the characteristics of learners,
- c) Selection and organization of content,
- d) Selection of media,
- e) Evaluation, and
- f) Feedback.

After going through all the above definitions of the educational technology, you can conclude that the chief role of educational technology is to improve the effectiveness and efficiency of the teaching and learning process. Educational technology as it exists today is the result of the integration of the technological devices with the newly explored psychological principles of learning, teaching, behavioral modification, etc.

In short, educational technology, in its widest sense can be understood to be including the development, application and evaluation of systemic knowledge about learning and instruction to teaching and training with the aim of improving their quality and efficiency.

According to Ellington et.al. (2005), this increase in the efficiency due to the use of educational technology in various situations can be manifested in many different ways, which are as follows;

- a) Increasing the quality of learning or degree of mastery among the learners;
- b) Decreasing the time taken by learners to attain the desired goals;
- c) Increasing the efficiency of teachers in terms of numbers of learners taught, without reducing the quality of learning;
- d) Reducing costs, without affecting the quality; and
- e) Increasing the independence of learners, and the flexibility of education and training provisions.

The scope of educational technology encompasses educational objectives, media and other characteristics, criteria of selecting media and resources, management of resources as well as their evaluation.

Till now, we have discussed that educational technology is the means for effective learning. But the effective learning could only come through the effective application of educational technology, which in turn is dependent upon the proper integration of hardware with the appropriate software. For example, an interactive television, which is a highly developed hardware, cannot provide quality output if it does not have quality educational programmes.

Now, this is understood that both the hardware and the software are needed for the effective use of Educational Technology. Although hardware is an important component, but it is of little use if suitable software is not available. Thus, what is needed is both technology in education and technology of education. Let us reflect on these terms more closely.

1.3.1 Technology in Education: Hardware Approach

Technology in education is also called the hardware approach to educational technology because it is concerned with the electronic gadgets such as television, radio, language labs and various other projected media, which are being used to educate learners. Technology in education includes tangible aspects of technology. This side of educational technology has been derived from the principles of physical sciences, as the main thrust is on the development of the electronic equipment like computer and its monitor, cameras, mobiles, television, etc. which could be used in the teaching-learning process.

1.3.2 Technology of Education: Software Approach

Technology of education approach to educational technology involves systematic, application of appropriate scientific research, both from the physical sciences and from the social sciences such as psychology and sociology to solve a problem. Here, it is important to understand that Technology of Education emphasizes on the techniques of teaching and learning derived from the principles, ideas and practices drawn from various fields of knowledge like psychology, sociology, philosophy, management studies, cybernetic, etc. in order to optimize the teaching-learning process. In other words, we can say that the technology of education includes 'intangible' aspect of education. For example, teachers or trainers use a number of methods and technique while organizing instructional programmes. Methods like inquiry teaching, simulated teaching, programmed instruction, computer-assisted instruction are the results of application of pedagogic principles derived from psychology of education.

Check Your Progress 1

Notes: a) Write your answer in the space given below.

b) Compare your answers with those given at the end of the unit

1) Define educational technology in your own words.

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2) Differentiate between technology in education and technology of education.

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1.3.3 Meaning of ICT

Information Technology (IT) and Information and Communication Technology (ICT) are very often interchangeably used in the context of modern technology infrastructure. ICT is a broad and comprehensive term, which comprises information technology and communication technology. Information technology includes radio, television, computer and Internet, teleconferencing and mobile. All these information technologies are powered by mainly two types of communication technologies. These are satellite based communication and terrestrial based communication. Satellite based communication is the communication, which takes place between sender and receiver through a communication satellite whereas terrestrial based communication is the communication, which takes place through a network of transmitters spread across a geographical area, a country, or a state. This type of communication is used in the transmission of radio and television in India. However, with the launch of a series of satellites by Indian Space Research Organization (ISRO), satellite based communication is being used for telecommunication. The components of ICT are presented in Fig.1.1.

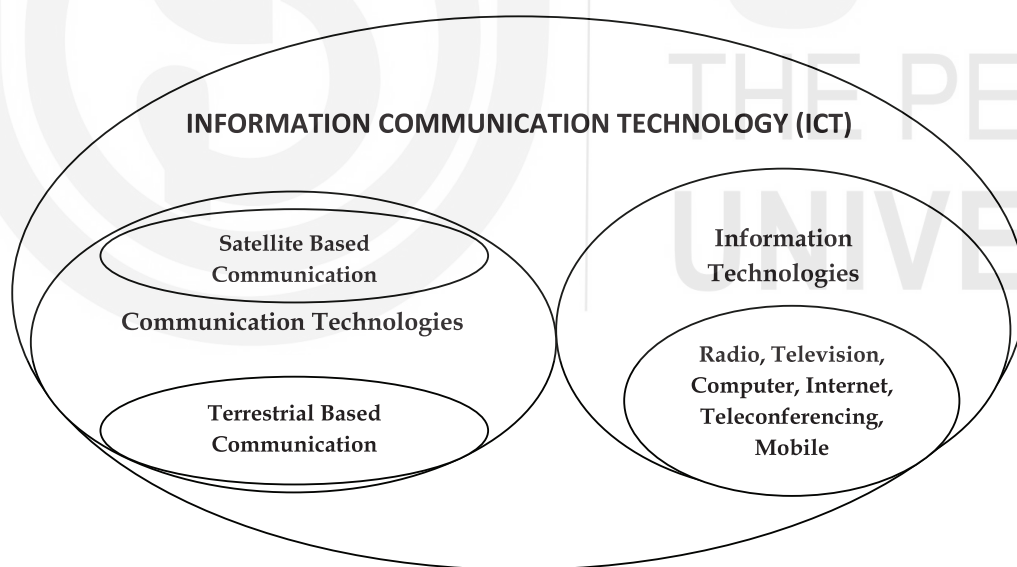


Fig. 1.1: Components of ICT

Communicating information effectively by making use of appropriate technology is called information and communication technology (ICT). In all, ICT is an umbrella term that includes many communication devices such as radio, television, cellular phones, computers and network, satellite systems and so on. There are many definitions of ICT. ICTs are defined, as a “diverse set of technological tools and resources used to communicate, and to create, disseminate, store, and manage information.” These technologies include computers, the Internet, broadcasting technologies (radio and television), and telephony, etc.

According to the United Nations Development Programme (UNDP): “ICTs are basically information handling tools — a varied set of goods, applications, and services that are used to produce, store, process, distribute and exchange information. They include the “old” ICTs of radio, television and telephone, and the “new” ICTs of computers, satellites and wireless technology and the Internet. These different tools are now able to work together, and combine to form our “networked world”, a massive infrastructure of interconnected telephone services, standardized computer hardware, the Internet, radio and television, which reaches into every corner of the globe.”

According to C-DEC, Department of Information Technology, Government of India “the term, information and communication technologies (ICT), refers to forms of technology that are used to transmit, store, create, display, share or exchange information by electronic means. This broad definition of ICT includes such technologies as radio, television, video, DVD, telephone (both fixed line and mobile phones), satellite systems, computer and network hardware and software; as well as the equipment and services associated with these technologies, such as videoconferencing, e-mail and blogs.”

Check Your Progress 2

Notes: a) Write your answer in the space given below.

b) Compare your answers with those given at the end of the unit

3) Explain the term ‘ICT’?

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4) On the basis above discussion, enlist the technologies, which are included under ICT?

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1.3.4 Transition from Educational Technology (ET) to Information and Communication Technology(ICT)

The nature of learning has moved from group learning to individual learning. Technology, to support the various kinds of learning, has also evolved at the same time. In this section, we will discuss the transition of educational technology to ICT. These technologies have passed through four phases which are as follows:

a) Audio-visual phase

- b) Psycho-sociological phase
- c) Cybernetic phase
- d) Information and Communication Technology phase

i) Audio Visual Phase

J.A. Commenius prepared a first 'visualized book' that contained 150 pictures and also said 'let pictures be the source of delight to the children and let these become familiar with them before they enter school'. Later, philosopher like Rousseau also said that learning process must be directed to the learner's natural curiosity and Pestolozzi put action to his words by proposing the 'object method'. The object method is based on instruction via sense perception. Although attempts on the use of concrete aids were made much before, but the intensive development in the audio-video started in the 20th century.

This phase is designated as an extensive use of variety of devices such as moving pictures, radio, slide films to transmit ideas and experiences, which appeal to the sense perceptions of the learners especially about the abstract concept. In other words, you can say that these devices act as supplementary devices. The audio visual device utilizes more than one sensory channel (for example, while watching any educational programme on television, you are using both the visual and auditory perception), which helps in clarifying, establishing and correcting the concepts, interpretations and appreciations. However, the materials to be used along with these audio visual aids need to be developed based on the psychological principles of learning.

Also these aids have always been used as a tool to disseminate the knowledge from one place to another. In this process of transmitting the information, it is considered important to transfer the correct message.

ii) Cybernetic Phase

This phase of educational technology has evolved during the Second World War. The word 'cybernetics' was first used by Norbert Wiener (1948) to define the automatic control systems. Wiener defined cybernetics as the science of control and communication in men and machines. Consider a situation, when you are browsing an Internet site, suddenly, a message pops up on the screen, that there is a "Virus" which has entered your computer. Here, the anti-virus software provided you the feedback and as a result you removed the virus from your computer. Cybernetics lays emphasis on feedback. The feedback here refers to a kind of reciprocal interaction between two or more events in which one activity generates a secondary action that in turn redirects the primary action. It is also defined as the comparative study of human control.

The feedback mechanism has three functions:

- a) It propels the system towards the target or the defined path;
- b) It compares the effect of this action with the true path and detects any deviation negative or positive; and
- c) It utilizes error signal to redirect the system.

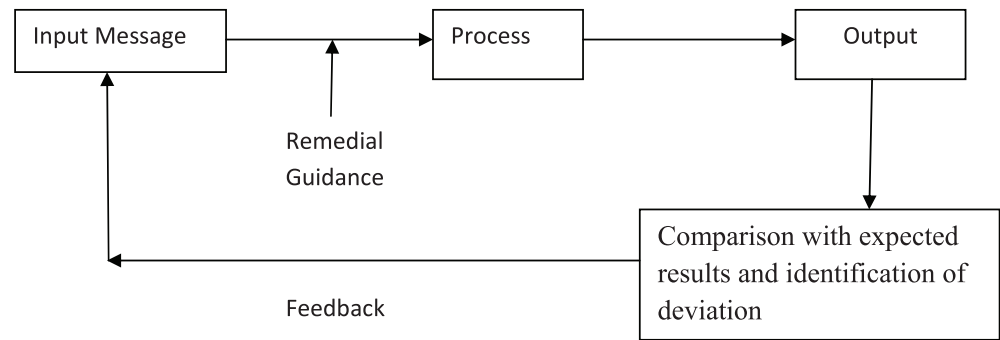


Fig. 1.2: Cybernetic Model

Source: Kulkarni, S.S. (1986) Introduction to Educational Technology, New Delhi: Oxford & IBH Publishing Co.

In most of the industrial processes, which emerged during and after World War II, the concept of feedback became operational for correcting any deviant step. For example, in a refrigerator, the thermostat informs the system of cooling whether a certain temperature has been reached or not reached and instructs it to perform accordingly.

This information for remedial action (steering the boat according to the charted path avoiding any deviations) was crucial not only in industry but also in education. Out of this emphasis arose the programmed learning instruction movement where it was emphasized that at every step a student should be told/reinforced about his/her progress (or deviation).

Thus, the cybernetic principles have led to the concretization and direct application of principles to teaching and learning. These cybernetic principles have the following implications for teaching-learning:

- a) The activity involved is geared to the learner's stage of growth-physical and cognitive.
- b) The learner is provided with some criteria for indicating to him/her specifically what progress he/she is making.
- c) The learner is presented with the activity both in verbal and non verbal context in varied situations.

iii) Psycho-Sociological Phase

This phase has a long history, which can be traced back to the learning theory on the laws of learning given by Throndike, 1913. Based on his theory, Pressey (1926) developed a teaching machine. This machine provided an automatic scoring device to the learners for immediate feedback. So, this was the first step towards the formulation of systematic learning. Subsequently, the theory of B. F. Skinner (1953) on operant conditioning, whose main contribution was that human behavior could be shaped, opened a new chapter in the development of programmed learning materials.

Teaching Machines

Learning, as you know, involves both learner and teacher but now with the development of technology, the physical presence of teacher may not be required. Teaching machines represent this development in education. Teaching machines act as a liberating device that bridges the gap in student learning due to die

individual differences. In 1924, Sidney L. Pressey created a crude teaching machine suitable for rote-and-drill learning. He showed that automated-instruction facilitated learning by providing for immediate reinforcement, individual pace setting, and active responding. According to him, “teaching machines are unique among instructional aids, in that the student not merely passively listens, watches, or reads but actively responds. And as he does so he finds out whether his response is correct or not and a record may be kept which aids in improving the materials”. These machines ranged from a very simple to complex.

A teaching machine incorporates a closed loop system of teaching that cyclically:

- a) display an information to learners,
- b) seek learner response,
- c) evaluate, reinforce and control next display.

Based upon the responses in the teaching machines, they can be broadly classified under two categories;

- a) **Constructed response devices:** These devices are based on the Skinner's principle, namely emission. of response is considered more effective in learning than simple recognition.
- b) **Multiple choice machines:** In these machines, it is possible to prepare branches for every reply to a given question.

The greatest value of such machines is the individualized instruction, which helps the learner learn at their own pace: Also, it provides well-designed and structured learning situation for desired behavioral change in the learner. But it has a limitation too, as a good teacher can always determine the effective and ineffective communication and modify his/her teaching on the basis of the students responses, it is not possible with the teaching machines.

In addition to the contributions made by the behaviorist, cognitive psychologist who lays main thrust on information that is perceived and processed by an individual has a profound implication on the pedagogical perspective about the meaning of learning.

With the adoption of the philosophy of a “constructivist” framework, the meaning of learning has changed from just the assimilation of information where teacher was thought to be the generator of knowledge and student as receiver of knowledge. Hence, from this theory it is clear that learning is an active process of constructing meaning on the part of each individual learner's experiences.

These different meanings of learning have implications on how we approach each educational content and on how educational technology has to be incorporated coherently with the teaching and learning practices.

Human being, as you know, is a social being. Hence the importance of observing and modeling the behaviors, attitudes, and emotional reactions of others is common phenomenon. Sociologists, particularly the school of group dynamics have also contributed a lot to the understanding of the teaching-learning process, through their work on 'group processes'.

iv) **Information and Communication Technology (ICT) Phase**

Recent innovations in information communication technology have revolutionized

the means of instruction. Now, we are using Multimedia, E-mail, Internet, intranet, website and mobile to impart instruction. These are telecommunication modes through which instructional materials can be given to students. Development of the bandwidth for the Internet and intranet has enabled teachers to impart instruction within and outside the organization.

This stage is also marked with the advances in the software and hardware potential of the systems. Several organizations like, audio video research center, educational media research centers and different departments of education and educational technology are engaged in the development of educational software. As you know, open and distance learning system uses all kind of information and communication technologies like television, radio, interactive radio technology, teleconferencing, computer conferencing, mobile technology in the delivery of instructional inputs. Moreover, due to advancement in ICT and mobile technology, online teaching and online learning are becoming popular among educational institutions, teachers and learners. Virtual teaching, virtual workshops and virtual meetings are being conducted through different web platforms.

1.3.5 Convergence of Computing and Telecommunications Technologies

In the past technological devices used only one medium. For instance a radio or an audio tape recorder were audio aids. They did not have the capacity to show the visuals. The films and televisions were the beginning points of integration of media. The computers take us a step further. Apart from audio and video facilities, it can also give us access to texts. Convergence of technologies underlies the modern trend in education. Why is it so? It leads to the merging of digital communication technologies, computing and digital media, and the resulting technology can facilitate communication, computing, education, entertainment, etc. round the clock through a single device, which can be as small as a cell phone. This facility through telecom and IT networks, is facilitating teaching and learning and making it a collaborative process. Hence, convergence of technologies has been described as the hallmark of the present information age by the department of IT, India (<http://www.mitgov.inlccibt.asp#l>).

Convergence of technologies for computing and telecommunications enables access to information in multimedia through a single device. Hence, there is the demand for a system that allows the merger of technologies. Technologies that otherwise operate separately and singularly are now synergistically combined for heightening the efficiencies of the resulting converged technology.

Converged technologies make learning interactive and can enrich it by linking users to sources of information as the Internet or even online libraries. It thus converts the learning scenario into a virtual classroom. An example of converged technology is the cell phone, increasingly incorporating different technologies such as the digital cameras, mp3 player (digital audio player), camcorder (digital camera with facility for capturing both video as well as audio), voice recorder, etc. They can also be used as computing devices and also connect the user to the Internet.

We thus see that convergence combines three major technologies - broadcasting, telecommunication and computing. Information is shared as content that can be processed, stored and exchanged as per the convenience of the users and this has immense potential for distance education. Today, technology integration

may require a multi media arrangement with teachers and learners resorting to several different devices like radio, TV, computer, phone, etc. But convergence of technology will enable learners to get all the facilities through a single device. Hence, cell phone may be that device in the coming days.

Source: IGNOU: Unit19 Technology Integration for teaching and Learning, p.35, Block-5: Appropriate Technology in MES-032 : Communication and Information Technology, <http://egyankosh.ac.in/handle/123456789/4866>

Check Your Progress 3

Notes: a) Write your answer in the space given below.

b) Compare your answers with those given at the end of the unit

5) Differentiate between the first phase and the last phase in the evolution of educational technology and ICT.

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6) What are the important implications of cybernetics for learning?

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7) What do you mean by convergence of technologies?

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1.4 FREE AND OPEN SOURCE MOVEMENT IN EDUCATION

The use of educational technology and media in the teaching-learning process in India can be traced back to the programme on Educational Technology which was initiated in the year 1972. Although the first National Policy on Education was formulated in 1968, there was no mention of use of technology in teaching-learning process. Later on, National Policy on Education (NPE), 1986 (and again modified in 1992) mentioned the use of educational technology for improving the quality of education. The suggestions made by the NPE (1986) included strategies for expansion of TV and radio programmes, in-house development of educational programmes, organisation of training programmes, provision for supply for TV and radio set to all schools, etc. Thereafter, the 7th Planning Commission suggested Centrally sponsored educational technology programme. In 2004 Information and Communication Technology (ICT) was introduced in teaching-learning process. This highlighted the partnership among state and union territories for providing computer aided education, establishment of smart schools, exclusive ICT teachers and in-service programme and development of

e-content with the support of Central Institute of Educational Technology (CIET) and Regional Institutes of Education (RIEs). The first National Policy related to ICT i.e. National Policy on Information and Communication Technology for School Education was formulated in 2011 and later on revised in 2012. The Policy stressed on the use of technology in the teaching –learning process. In higher education, the National Mission on Education through Information and Communication Technology (NMEICT) suggested various measures to enhance the use of technology. As a result of all these policies, use of technology in educational sector has gained wide momentum. Also, some of the policies advocate the use of free and open sources in education. So, in the proceeding section, we will discuss more about free and open sources and open education.

With the widespread use of technology, there has been increasing uses of free and open sources in educational activities. Let us understand what free and open source is. We have been using Microsoft Word or PowerPoint by making payment to Microsoft Company, which owns the software. Similarly, the computer is operated with the help of system software developed by Windows. And we pay for it. But there are many software which are available free i.e. whoever uses the software does not have to pay for their uses. In 1980s, the social movement, free software movement (FSM) or free/open-source software movement (FOSSM) or free/libre open-source software movement (FLOSSM) gained momentum that grants the users of the software certain freedoms i.e. freedom to run software, change and redistribute software with or without changes. This movement impacted the educational system too. As a result, the concept of open education emerged. The term ‘open education’ is very broad. The word ‘open’ in education simply denotes the freedom of the individual to complete any educational programme/course of his/her choice whenever he/she likes. In such case, the individual has the freedom to enrol/take admission in educational programme, appear for examination, whenever they like. This is the broad meaning of open education.

Open education as discussed is a very broad term. As we know, there are three modes of education, which are currently used for teaching-learning purposes. These are conventional (face-to-face), open and distance and blended learning modes. But the open education, that we discuss here goes beyond these primary modes of education. Open Education Consortium (<https://www.oeconsortium.org/about-oe/>) describes “Open education encompasses resources, tools and practices that employ a framework of open sharing to improve educational access and effectiveness worldwide. Open Education combines the traditions of knowledge sharing and creation with 21st century technology to create a vast pool of openly shared educational resources, while harnessing today’s collaborative spirit to develop educational approaches that are more responsive to learner’s needs. Open Education seeks to scale educational opportunities by taking advantage of the power of the internet, allowing rapid and essentially free dissemination, and enabling people around the world to access knowledge, connect and collaborate. Open is key; open allows not just access, but the ability to modify and use materials, information and networks so education can be personalized to individual users or woven together in new ways for large and diverse audiences”

Along with the open education, open source software (OSS) also gained momentum. Open source or open software (OSS) is any computer software application distributed with source code that may be read or modified by users. Once the source code is available, the users can modify, fix bugs, improve functions, etc. A software in order to be considered as open source needs to meet the criteria such as:

- i) the software programme must be freely distributed;
- ii) the source code must be included in the programme;
- iii) the users must be able to view, modify, edit the programme; and
- iv) the modified programme must also include source code and can be redistributed.

Some of the open sources are: operating systems (e.g., Linux), databases (e.g., PostgreSQL), applications (e.g., OpenOffice.org), games, and even programming languages (e.g., Python). Since OSS are free to use, many educational organisations and teachers use open software and promote their usage among stakeholders of education.

1.5 CURRENT TRENDS OF TECHNOLOGY USE IN EDUCATION

You might have observed that, today, when someone receives an e-mail (for example, an email in his/her Gmail account), it shows three replies that the receiver can choose from and send the relevant reply so that he/she does not have to type the reply. Let us understand what happens here. The Gmail automatically senses the content of the message received and probable replies are generated so that the receiver may choose a suitable reply from these replies. This may be an example of lower level of artificial intelligence. There are technologies employing advanced level of artificial intelligence. Now let us discuss a second case i.e. the ubiquitous learning. Ubiquitous learning is defined as “learning with u-computing technology” (Yang et al., 2008). In U learning, the students have the freedom of learning anywhere and anytime using hand held devices. Also, teachers have the facility to track students and similarly students get instructions for their learning. Thus, there are many advanced technologies that support education in various ways. Today, along with conventional (face to face) learning, blended learning and open and distance learning (ODL) have gained popularity in providing individualised learning due to use of ICTs in teaching-learning process. Irrespective of the mode of education, many latest technologies have been experimented and are in practice and a few of them are described in the coming sections:

1.5.1 Learning Analytics

The emergence of big data, predictive analysis and data mining, etc have impacted the education system in a bigger way. Let us see how they help the education system. Suppose thousands of learners enrol in an online programme, may be a Massive Open Online Course (MOOC) or any other online programme of 12 weeks and completes the programme. While the learners undergo the programme, the data pertaining to them are collected, documented and stored. Thereafter, the data is analysed to make decisions about the nature of learners enrolled, category of learners, qualification criteria, marital status, nature of job, time of submission of assignments, time of attendance, performance in the tests, nature of results, participation in discussion forum, etc. For example, if most students fail to give correct answer to a particular question in a quiz, the data may help the instructor make various decisions. Similarly, if a few students respond to a particular chat topic (posted by the teacher) then, it may help teacher to make a decision that the topic is not understood by most of the learners. These are some of the examples. Thus, learning analytics helps the teachers, administrators, and policy makers to critically analyse the data to formulate future strategies to improve educational practices and teaching -learning experiences.

The NMC 2016 Horizon Report(Higher Education Report) reported learning analytics as one of the digital strategies that can impact education system and defines learning analytics as “an educational application of web analytics aimed at learner profiling, a process of gathering and analysing details of individual student interactions in online learning activities”. According to Siemens (2011), “Learning analytics is the measurement, collection, analysis and reporting of data about learners and their contexts, for purposes of understanding and optimising learning and the environments in which it occurs”. In other words, learning analytics can be defined as the process of measurement, collection, analysis and reporting of the data pertaining to learners, their performance, experiences, learning programmes with a view to devising strategies to improve educational practices and organisational performance. Or simply learning analytics describes the process of collection of data about learner during the educational process with the aim of improving teaching and learning practices. Thus, learning analytics is primarily concerned with collection and analysis of students’ data. In comparison to technology enabled learning environment, data is not structured and well organised in conventional learning environment (face to face). But the learning analytics and data mining tools help teachers/instructors/ administrators/policy makers etc, understand better to organise unstructured data into structured format, ‘how students learn’ and also to suggest methods to improve the educational system. Learning analytics helps them to make predictions about the future performance of students.

1.5.2 Virtual Reality& Augmented Reality

Suppose a teacher wants to teach the structure of human body to her student, then normally during the teaching session, she may show images/photographs from the text book or the picture drawn by him/her. Generally, text book images or pictures drawn by a teacher are two dimensional (2D) in nature. But today, digital technologies have made things easy and can develop three dimensional (3D) view of any real objects/materials. Such digital technologies come under the broad term ‘virtual reality’. Virtual reality (VR) is an artificial, computer-generated simulation or recreation of a real-life environment or situation. VR is a computer technology to develop a simulated experience. VR is the digital recreation of a real world. As the name indicates, the environment/situation doesn’t exist in real but a virtual feel is reproduced using digital technologies. Virtual reality provides opportunity to experience different planets, geographical locations, human body structure, automobile engine, aeroplanes, ocean, playground, classroom, school, railway station, bus parking station, etc. Thus, anyone watching virtual reality gets the real feel without visiting the real paces/environment/situation and you can move around like as if you are physically there. VR can be watched over computer, tablets, mobiles, etc by wearing aspecial VR headset or head mounted display(VR viewer or) like Oculus Rift or VR apps, such as Google Cardboard or Daydream View.

What about augmented reality? The word meaning of augmentation is ‘increase the size or value of something’. Augmented Reality (AR) is defined as "an enhanced version of reality created by the use of technology to add digital information on an image of something. AR is the technology of recreating a real world but adding a layer on the top of the view with digital elements like texts, images, photographs, or sensations i. e. a real world is augmented by computer generated component. AR is the mix of real world and virtual world. Thus, AR also helps to get a view of various places, towns, restaurants, banks, schools, buildings, etc without visiting the real places. Generally, AR is being watched

using mobile devices like laptops, smartphones, tablets, etc. Similarly, special AR headsets, such as Google Glass and AR apps can also be used. Some of the popular examples of AR includes Snapchat lenses and the game Pokemon Go. A more advanced version of VR and AR is the Mixed Reality (MR) that combines the technologies of both AR and VR.

1.5.3 Gamification

Gamification is simple but powerful tool that enhances learning ability of students. As you know, the word ‘game’ refers to activity that individual engages himself/herself with. Football is a game played between two groups but there are games which are played by an individual alone. Anyhow, an individual or a group wins at the end of the game. The principle of game when applied to non-game environment, then such process is called gamification. In 2002, Nick Pelling coined the term ‘gamification’ and defines gamification as “applying game-like accelerated user interface design to make electronic transactions both enjoyable and fast”. Gamification is “the use of game mechanics and experience design to digitally engage and motivate people to achieve their goals” (Gartner, 2014). Gamification is the application of gaming mechanics (or game principles, game design elements) to non-gaming environment/context. In the context of education, students are put into challenging situations to which they are required to find a solution, this is similar like playing a game but in a non-gaming context. For example, when students are asked to attempt a quiz, this is considered similar to games but in the context of education. Similarly, directing children to find answer to a problem by searching Internet is also a form of game. Thus, gamification has great implication in the technology enabled learning environment.

1.5.4 Flipped Learning

Flipped learning is a pedagogical approach in which the conventional classroom-based learning is inverted, so that students are introduced to the video learning material before they come to class and apply what was learned at home to deepen learning through discussion with peers and problem-solving activities facilitated by teachers. Teachers do not engage students listen to their lectures but recorded videos of the subject matter are provided online to the students and they watch the videos outside the classroom preferably at home. Students are directed to watch videos before they come to the class so that they may develop some understanding and knowledge of the subject matter going to be really discussed later in the classroom. Thus, students develop understanding of the topic before they really discuss it in the classroom. The discussion is facilitated by the teacher and helps students to develop deeper understanding of the subject matter. In the beginning online videos are made available to the students but later on even pre-recorded videos can also be provided. You will learn more about flipped learning in the Unit 5 of this Course.

1.5.5 Artificial Intelligence

You might have seen people playing chess in mobile devices like computers, mobile phones, etc. As we know, chess is usually played between two people but when someone plays chess with a computer, only one individual is visible. The role of the second individual is played by the machine (computer). In this situation, computer behaves like a human mind. Similarly, today while people search on the Internet, they can speak the key word of their search to the machine to which machine replies by giving some answers. Also, there are many machines like automatic cars which react to human instruction. Even such machines have the

capability to or automatically sense the human desires/environmental conditions and react accordingly. These are some of the examples of artificial intelligence (AI). AI is the branch of computer science concerned with development of smart machines (intelligent machines) that work and react like human beings. Artificial intelligence (AI) is the simulation of human intelligence processes by machines, especially computer systems. The intelligence of the human and animals are considered natural intelligence and when it is mimicked in a machine, such an intelligence is called artificial intelligence. Thus, the machines developed using AI theories behave just like humans and have the capability to listen, think, reply, etc. AI principles have applications in health care, automobile industry, defence, advertising, art, education, etc.

In education, AI has a lot of applications like in tutoring learners, providing personalized learning inputs, testing learner performance, automated tasks, smart content, machine learning, etc. Tutoring or intelligent tutoring systems (ITS) replicates the real classroom teaching process in digital format that can behave like a real classroom. This kind of machine learning also supports the principles of personalised learning. AI can also automatically generate questions, assess students, provide feedback to them and accordingly necessary instruction may be given to improve their performance. AI is also helpful in automated tasks like taking attendance, grading assignments, and generating test questions.

1.5.6 3D Printing

3D printing is an innovative process of manufacturing a physical object in 3D form from digital file/digital designs. 3D printing is also called additive manufacturing because 'additive' refers to the successive addition of very thin layers leading to the formation of objects. Thus, in 3D printing, first digital design files of 3D object are designed in computers. Then the 3D model is converted into 3D printable ready format i.e. 3D design is divided into hundreds or thousands of different horizontal layers. This process is called slicing. Thereafter, print command is prompted to print it. Before printing the 3D, printer is loaded with plastics, ceramics, resins, metals, sand, textiles, biomaterials, glass, food and even lunar dust, etc. Once printer command is given, the 3D model of the object is printed with any the selected materials. The 3D printer is not a big machine but small in size as the normal inkjet printer is and printing process is similar to normal printing process but in place of ink, materials like plastics, ceramics, resins, metals, etc. are used. In education, the 3D printing technology may be employed to create complex models which are manually impossible. This motivates and generates interest among learners and learning is enhanced.

1.5.7 Social Media Learning

Social media are technology platforms that help to connect people virtually. The most popular social media platforms include social networking sites (SNS), blogs, microblog, wiki, social bookmarking, etc. Social media encompasses tools to develop and share content, maintain social relations by building social networks. Thus, social networking is one of the major features of social media allowing people to create networks that connect different people and help them develop, share and exchange information of varied nature like message, image, photographs, videos, links, etc. When social networking sites are used for educational purpose, such networking is called educational social networking. For example, a teacher develops a Facebook page or twitter account to disseminate the information related the teaching learning process coordinated by him/her. This is a form of social media learning or social networking.

1.5.8 Internet of Things (IoT)

IoT is a concept basically connecting physical devices with an IP address and on and off switch to the Internet that can collect and transfer information and data over a network without manual assistance or intervention. Simply, it refers to connecting all materials/object in the world to Internet so that one can control the device from anywhere. The 'thing' in IoT refers to the digital devices like computers, sensors, cell phones, coffee makers, washing machines, headphones, lamps, wearable devices, etc. How does IoT help? Suppose, if you require an 'image' for teaching your students and the same is not available in the cell phone. In such a case, you may send an information (may be through google search) and the image is received in your cell phone. It is not necessary that the image is stored in your cell phone but can be anywhere/ in any device. Let us take another example. A patient with a pacemaker attached to his/her body can be controlled by the doctor sitting at some other place. All these are possible with the help of IoT. The term "Internet of Things" is coined by Kevin Ashton of Procter & Gamble. IoT has also a lot of applications in education. For example, a teacher can monitor the activities of his/her students sitting at his/her home

1.5.9 Cloud Computing

As a teacher, you might have accessed and developed various educational resources. Suppose, you develop a video programme in your school, where will you store? Usually, the storage space (hard disk) of the computer or laptop is used to store the video. But there is risk of losing the video because of various reasons like malware/virus issues, software upgradation, unknowingly deleting files, etc. And if you want to access that file at places other than your work place, you have to always carry that device with you. In order to get rid of such risks and to access data from multiple devices, cloud computing would be a great choice. Cloud computing refers to the delivery of different computing services such as software development platforms, servers, data storage, databases, networking, application services, software and other IT resources via Internet, often referred to as the "cloud." The name cloud computing was inspired by the cloud symbol that is often used to represent the Internet in flowcharts and diagrams. At the same time, the information accessed is stored in the cloud or virtual space. Apart from storing data files, cloud computing provides various other services such as access to application software, accessing data, etc. Thus, data and applications can be accessed from anywhere in the world through Internet. There are public (free), private (paid) and hybrid (mix of public and private) cloud computing services.

Cloud computing has a lot of applications in the field of Education. For example, if a student wants to create a textual report, Google docs (a free cloud service to develop texts) may be used rather than purchasing costly office software. Such document files can also be accessed, edited and shared from anywhere. Cloud computing is compatible with almost all digital devices. Thus, cloud computing is cost effective. You do not have to spend huge amount in purchasing costly computers or other digital equipment or any software. Similarly, the students can access text books, videos, audio, and other learning resources and store the same in cloud storage space like google drive, drop box, etc. There are many online programmes that avail the services of cloud computing. Those programmes store the learning materials in the cloud storage space. Students can enrol in such programme and earn degrees.

1.5.10 Digital and Open Badge

As we know, after the completion of any course/programme, students are awarded with certificate (printed hard copy certificate or degree certificate). The certificate is the proof that the students have successfully completed the course/programme and acquired the requisite skills. In recent years, along with physical certificate, the digital and open badges are being provided to students. The concept of digital and open badge was introduced by Mozilla, the global non-profit company, best known for the Firefox web browser. What are digital and open badges? As we know, there are different ways to accomplish learning and mastery of skills. As mentioned above, printed certificate provided on completion of the course/programme is one of the ways. Today, many organisations and educational institutions are also offering online programmes. Even there are blended educational programmes too. The evidence of completion of such programmes or skill development programmes or faculty development programmes is obtained either through printed certificates or digital badges or open badges. So basically, digital and open badges are an indicator of accomplishment of skills that can be displayed, accessed, and verified online.

Digital and open badges are two terms. Digital badges are small digital images that represent an individual's learning within a specific domain. These images are embedded with rich metadata that increases transparency into what is actually learned (Gamrat, Zimmerman, Dudek, & Peck, 2014; Gamrat & Zimmerman, 2015). The digital images include metadata such as details of badge issuer, badge earner and course/skills earned. On the contrary, open badges are a type of digital badges. Open Badges are verifiable, portable digital badges with embedded metadata about skills and achievements. The metadata includes, Badge Name, Badge Criteria (Often written in the description section), Badge URL, Issue Date, Issuer (an account or record associated with the organization issuing the badge) name, Recipient (an email or user account associated with the badge owner). They comply with the Open Badges Specification (Open Badge standard) and are shareable across the web and displayed via online CVs and social networks. Thus open badges take digital badges a step further. To earn open badges, individuals can enrol in programmes/courses run by organisations/institutions offering open badges.

1.6 MINIATURIZATION OF TECHNOLOGY

You must have heard an old saying 'Beautiful things come in small packages'. Today, it can be altered and said 'Powerful things come in small packages'. Technical devices are day by day getting smaller and lighter. The aim is to make them portable and easy to handle. Smaller gadgets consume less power and are more environment friendly as well as user friendly. Gone are the days of cumbersome machinery. The industrial revolution of the 18th century led to the manufacture of large ships, machines and other tools. Later on, huge ships, aircrafts were built as size of the possession was a matter of pride. Today, small but powerful technologies are in great demand. Moreover, with globalisation, humanpower including those in the field of education has to travel a lot and hence small size technological devices are needed. Miniaturisation of technology catalyses the process of integration of technology because it is easier to carry out technology integration for Teaching and Learning

Appropriate Technology Example: Mr. X, a student of Management Studies, carries a laptop to his college to acquire, feed and store information. Mrs.Y, a

wildlife photographer does her job with a handy cam. Mr. A carries a ring-size video camera for observing children at play.

Such miniaturized technology has now reached the field of education. Small sized radio, hand held video cameras or handy cams (camcorders), laptops, portable computers and notebooks and even palmtops i.e. hand held computers are common today. Today there are also hand held personal digital assistants. Miniaturisation of technology has been aided by wire free systems. Transistors, cell phones, computers, etc. can be operated without wired connections. Portable and small sized hard drives with huge data storing capacity are available.

Miniaturization of technology not only makes the tools light and handy and hence portable but also helps in individualizing education. Every individual learner who has an access to a laptop shall learn at his/her own pace and in his/her own style. We can visualize a scene when the school bag shall have a computer instead of books and notebooks.

Source: IGNOU: Unit19 Technology Integration for teaching and Learning, p.35, Block-5: Appropriate Technology in MES-032 : Communication and Information Technology, <http://egyankosh.ac.in/handle/123456789/4866>

Check Your Progress 4

Notes: a) Write your answer in the space given below.

b) Compare your answers with those given at the end of the unit

8) Write any two features of 'Open Education' in the context of Free and Open source Movement in Education.

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9) What is virtual reality?

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10) Define Flipped Learning.

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11) Who is Internet of Things (IoT) attributed to and what is it ?

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12) Differentiate between digital and open badges.
13) Give three examples of miniaturization of technology.

1.7 ICT USE-ADRESSING ISSUES AND CONCERNS

The limitless advantages of using ICT for instructional purposes in both school and higher education have been cited by different research studies. Similarly, the disadvantages and challenges in organising ICT based classrooms is a big concern for the stakeholders of education. The challenges are of different nature and include lack of trained teachers, non-availability and maintenance of ICT infrastructure, lack of adequate funds, shortage of time to prepare ICT based learning resources, lack of technical support, quality of the existing ICT based educational resources, language issues, internet issues, social and ethical problems, lack of administrative and management support, issues related to accessibility of ICT resources, lack of competencies to handle ICT , issues of training , teachers attitudes towards using ICT, etc. In spite of issues, ICT use is being used at all levels of education owing to its capacity to enhance the learner performance. Let us discuss some issues and concerns of ICT use.

1.7.1 Quality Issues

How do we assess the progress of students in their learning? Verbal questions or pen and paper pencil test methods are used to assess student learning. We have discussed the concept of gamification in section 1.5. Gamification is the use of game principles in non-game environments. Suppose, a teacher uses ‘gamification’ in the teaching learning process. At the end of the teaching process, he/she asks students to attempt MCQ questions provided in the computer/tablet. This is an example of application of technology to assess the progress of students using gamification. The use of gamification not only engages students in their learning but at the same time helps them retain their learning for a long time and ultimately leading to quality of learning. Quality of education is a broad term and encompasses various parameters such as quality of teaching, quality of learning, quality of teaching -learning resources, etc. Quality of education has been a concern and issue of education for a long time. Use of technology, to a great extent, helps address the concerns and issues of quality education.

Quality of education pertains to various aspects of education system such as: curriculum, learning materials, teaching-learning process, assessment and evaluation, school infrastructure, etc. Technology can play a significant role in all aspects of education to enhance quality of education. One of the major quality concerns is related with the teaching-learning process. It has been observed that,

mostly teachers use lecture method to deliver instruction. But lecture method supplemented with technology enhances learning among students. For example, to teach concept of 'addition', any free software (websites) can be used so that students get an opportunity to alter different numerical values (values to be added) to find out the result of addition. Here the verbal teaching is supplemented with technology. Similarly, a lecture method supplemented by a video presentation (either self-made or available in the website) may be used to make children understand subject matter in a better way. These are some of the examples using technology in pedagogy. Technology also helps children with special needs by providing educational resources in the form of assistive technology. Thus, the use of technology improves the quality of delivering instruction.

In the above paragraph, we have discussed how technology facilitates teaching. Technology may also be used to improve learning of children. For example, students may prefer reading e-text over normal text book because they get an opportunity to watch video, listen to audio, visit websites, etc. in e-text and thereby get real feel of the subject matter through virtual experiences. Similarly, attending virtual lectures and conducting virtual experiments help children develop clear understanding of the subject matter. Similarly, there are many technologies which help children acquire knowledge in different subject matters and practise different skills. Apart from these, technology also engages children in learning activities and motivates them to learn and thereby improves their quality of learning.

Technology tools are also used to manage various forms of student data. Since the time a student is enrolled in a course/programme, till he/she completes the course/programme. the data pertaining to his/her family details, achievement in curricular and co-curricular activities, etc. may be stored and managed using digital tools. Even many organisations have developed their own educational management systems. Apart from managing student data, detailed information about the educational organisations can also be stored electronically. Such information include details of teachers, readmission register, stock register, etc. Thus, the quality of data management is improved with the use of technology.

1.7.2 Equality and Equity Issues

As you know, there are different types of learners such as visual, auditory, and kinaesthetic learners. Suppose a teacher uses laboratory method while teaching in a classroom. What would you think about which learners would be able to catch up better in such a classroom environment? Mostly, the kinesthetic learners may feel comfortable and learn better compared to others as they prefer learning by doing. Thus, whenever teachers organise lessons, they need to consider the type of learners. Similarly, many factors influence the development of lesson designing. This underlines the basic principle of equity in education. Equity and equality are two major concerns of education. Equity is giving everyone what they need to be successful. Equality is providing everyone the same kind of opportunity. How are equality and equity ensured in the education system? For example, a teacher develops an educational resource (video) and shows the same to her students. But there is every possibility that the video may not be suitable to children with visual impairments or those who prefer reading/writing learning style. In such a case, the teacher has not considered the individual learning style of learners with visual impairments. This violates the principle of equity in the classroom. Had the teacher followed the principle of equity, then he/she should have made available educational resources that suit individual needs of all categories of learners. Thus,

equity in education describes the organisation of teaching learning activities and experiences as per the individual needs of the learner.

The Constitution of India, Education Commissions like Kothari Commission, National Policy on Education, etc have highlighted and recommended various measures to ensure equality and equity in education. The Constitution of India declares equality as a fundamental right requiring to treat every individual equal before law, not to discriminate any one on the basis of caste and religion, providing equal opportunity in public employment, right to free and compulsory education, etc. Similarly, different Education Commissions from time to time have recommended measures like scholarship scheme, mid-day meals, free text book and school uniforms, remedial education and coaching classes, education of backward classes and women, free education, inclusive classrooms, common school system, provision of facilities like building, toilets, adequate teachers, etc to maintain equality and equity. Even then, Indian education system still suffer from the problems of equality and equity. Let us briefly discuss these concerns in the context of emerging technology.

As mentioned, technology has a lot of implications for education. Equity and equality may also be achieved through technology use. How do we ensure equality in education? For instance, a school provides its students access to computer/tablet or else provides tablets to each and every student, then equality is achieved. A teacher while teaching permits a few students of his/her class to access computer. This is a case of denial of equality. Now what about equity? A teacher asking children to read e-book (e-book with access facilities for children with special need) proves that he/she considers the interest of both normal and children with special needs. Thus, whenever teachers use any technology (devices and resources), they must always take into account of the special abilities of children.

1.7.3 Digital Divide

Suppose a teacher teaches his/her children using flipped learning method on a particular topic and therefore directs her children to watch the video posted by her online (Or else to watch a pre-recorded video). In such situation the students have to watch the video and come prepared to the next class to engage in discussion. Similarly, think of a situation where teachers ask children to prepare a presentation of a topic. In both cases, technology is being involved and students need to have computers, internet connectivity, etc. to complete those tasks. It may be possible that students may or may not have these facilities at their home. Thus, there exists a gap/divide between the students who have access to technology or information and communication technology (ICT) and those who have not access to technology. Such a gap/divide is called digital divide. Thus, digital divide is defined as the gap in terms of the access to and usage of information and communication technologies. Digital divide is the discrepancy between people who have access to and use ICTs such as computer, tablet, camera, etc and people do not have resources and access to ICTs. Thus, digital divide indicates the gap between accessing ICTs and skills to use them. Generally, digital divide exists between people living in rural and urban area, educated and uneducated, economically weaker and rich people, etc.

Along with other issues, the digital divide between the students also needs to be addressed to organise a better technology enabled classroom. Both the state and central governments have implemented various schemes and projects to organise

a better technology enabled classroom. To quote a few, Sourkaryan and E–Seva (Andhra Pradesh), The Bhoomi Project (Karnataka), The Gyandoot Project (Madhya Pradesh), , central government initiatives like Digital India Programme, Bharat Net, National Science Digital Library (NSDL) , Kisan Call centre (Ministry of Agriculture) and other governmental/non-governmental agencies and NGO programmes like Microsoft’s community technology skills programme (launched in Chennai), Unnati Project (Hindustan Petroleum Corporation Limited) , IIT Webel (software developed by IIT Kharagpur). Even there are many initiatives in the education sector that allows greater access to all sections of the society such as E-Pathshala, INFLIBNET, NROER, E-GyanKosh, etc. These initiatives allow students to access quality educational resources. The implementation of new ICT would minimize the digital divide to a great extent.

1.7.4 Multiculturalism

In a community or a society, there are different types of cultural groups; all of them practise their own cultural habits in the form of religions, beliefs, traditions, pattern of thinking, values, etc. In spite of their cultural differences, these groups coexist as a cohesive cultural unity with diversity. Thus, multiculturalism is the co-existence of diverse cultures, where culture includes racial, religious, or cultural groups and is manifested in customary behaviours, cultural assumptions and values, patterns of thinking and communicative styles. (<https://www.ifla.org/publications/defining-multiculturalism>). Multiculturalism manifests itself not only in social and cultural settings, but also in educational institutions. Learners with diverse cultural backgrounds come to educational institutions for pursuing academic programmes. They spend most of their time in the classroom attending to the teachings delivered by their classroom teachers. Teachers in a multicultural classroom use different kinds of technology to supplement their teaching. Ideally, these technologies such as PPTs, audio/video programmes, slide shows, etc. need to address the concerns of diversity of the learners in the classroom. Very often, it is found that technologies or ICTs used by teachers are not developed keeping in mind the diversities such as their languages, ethnicity, religions, cultural habits, beliefs, etc. Use of such technologies become deterrent in the learning of students., which need to be addressed not only by teachers but also by those who develop such technologies.

Check Your Progress 5

Notes: a) Write your answer in the space given below.

b) Compare your answers with those given at the end of the unit

14) What is equity issue in use of ICT? Give an example.

.....

15) Explain the meaning of digital divide.

.....

1.9 LET US SUM UP

In this Unit, we provided you with a broad understanding of educational technology. Technology results in new designs and devices to improve human productivity. Education is the process of acquiring and imparting knowledge crucial to the development of a learner, Therefore, educational technology is the application of the principles of education to improve human learning. However, there are two approaches to the understanding of educational technology, namely, hardware and software approaches. We explained the concept of ICT, differentiating between information technology and communication technology. Educational technology has transitioned through four different phases: Audio-visual phase, Psycho-sociological phase, Cybernetic phase and Information Communication Technology phase. In the context of ICT, we discussed free and open source movement. Latest technology uses in education like learning analytics, virtual reality, flipped learning, artificial intelligence, cloud computing, etc. were discussed. In the last section of the Unit, we focussed on issues and concerns in the use of ICT such as : quality, equality and equity, digital divide and multiculturalism.

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1.11 ANSWERS TO CHECK YOUR PROGRESS

1. Educational technology, in its wide sense, can be understood to be including the development, application and evaluation of systemic knowledge about learning and instruction to teaching and training with the aim of improving their quality and efficiency.
2. Technology in education is also called the hardware approach to educational technology because it is concerned with the electronic gadgets such as television, radio, language labs and various other projected media, which are being used to educate learners. Technology of education approach to educational technology involves a systematic, scientific application of appropriate scientific research, both from the physical sciences and from

- the social sciences such as psychology and sociology to solve a problem.
3. Information and communication technology consists of three specific terms, information, communication and technology. Communicating information effectively by making use of appropriate technology is called information and communication technology (ICT).
 4. Radio, television, video, DVD, telephone (both fixed line and mobile phones), satellite systems, computer and network hardware, computer software, Internet, mobile, etc. are included under ICT.
 5. ICTs like films, radio and television were popular which provided one way interaction but in the last phase the two way interaction became possible.
 6. The main implication of the cybernetics was the active involvement of the learner in his learning.
 7. Convergence of technologies means merger of a number of technological applications in one single device. For example, a mobile has several technological applications like audio, video, text, messaging, conferencing, etc.
 8.
 - i) The software programme must be freely distributed.
 - ii) The source code must be included in the programme.
 9. Virtual reality (VR) is an artificial, computer-generated simulation or recreation of a real-life environment or situation.
 10. Flipped learning is a pedagogical approach in which the conventional classroom-based learning is inverted, so that students are introduced to the video learning material before they come to class and apply what was learned at home to deepen learning through discussion with peers and problem-solving activities facilitated by teachers.
 11. Internet of Things (IoT) is attributed to Kevin Ashton of Procter & Gamble. It refers to connecting all materials/object in the world to Internet so that one can control the device from anywhere.
 12. Digital badges are small digital images that represent an individual's learning within a specific domain. The digital images include metadata such as details of badge issuer, badge earner and course/skills earned. On the contrary, open badges are a type of digital badges. Open Badges are verifiable, portable digital badges with embedded meta data about skills and achievements.
 13. Handy cams (camcorders), laptops, portable computers.
 14. Equity is giving everyone what they need to be successful. A teacher asking children to read e-book (e-book with access facilities for children with special need) proves that he/she considers the interest of both normal and children with special needs.
 15. Digital divide is the discrepancy between people who have access to and use ICTs such as computer, tablet, camera, etc and people do not have resources and access to ICTs.

*Please Note :

Sections : 1.1, 1.5 and 1.7 have been contributed by Mr. Ajith Kumar C. Asst. Professor, School of Education, IGNOU
