



MDE-418
Educational
Communication
Technologies

Block

1

COMMUNICATION TECHNOLOGY: BASICS

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**Student Assessment in Technology Enhanced
Learning and Evaluation of Technology** 109

MDE-418: Educational Communication Technologies

(New Course in place of ES-318: Communication Technologies for Distance Education)

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October, 2010

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ISBN-978-81-266-4875-7

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Further information about the Indira Gandhi National Open University Courses may be obtained from the University office at Maidan Garhi, New Delhi - 110 068.

Published by **Prof. Basanti Pradhan**, Director, Staff Training and Research Institute of Distance Education (STRIDE), IGNOU, New Delhi on behalf of the Indira Gandhi National Open University, New Delhi.

Cover design by M/s. ADA Graphics, New Delhi

Laser Typeset at : Tessa Media & Computers, C-206, A.F.E.-II, Jamia Nagar, Okhla, New Delhi.

Printed at : Public Printing (Delhi) Service

MDE-418: Educational Communication Technologies

Course Outline

Block 1 : Communication Technology: Basics

- Unit 1** : Introduction to Communication Technology
- Unit 2** : Communication Networks
- Unit 3** : Pedagogical Designs for Communication Technology
- Unit 4** : Managing Technological Change
- Unit 5** : Student Assessment in Technology Enhanced Learning and Evaluation of Technology

Block 2 : Technology Primer

- Unit 6** : Radio and Audio
- Unit 7** : Television and Video
- Unit 8** : Satellite-based Education
- Unit 9** : E-Learning
- Unit 10** : M-Learning

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- Unit 11** : Communicating with Graphics
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- Unit 16** : Email, Mailing Lists, Discussion Groups, RSS Feed
- Unit 17** : Web 2.0
- Unit 18** : Virtual Classroom and Virtual Reality
- Unit 19** : Reusable Learning Objects
- Unit 20** : Learning Management Systems

Block 5 : Learning Portfolio

INTRODUCTION TO THE COURSE

In the previous courses you have studied that distance education is primarily a technology mediated system of teaching and learning. Media (especially electronic media) plays a significant role in the delivery of educational opportunities to people who need education at their door-step, study at their own pace, time and place. Educator's trust with technology has been a story of evolution of the media itself. Starting from the use of blackboard and the printed textbook for mass education, educators have always experimented with the use of technologies to improve their teaching and learning at all levels. With the emergence of a variety of Computer and Communication Technologies, the process of adoption and adaptation of innovative technologies for the purposes of education and research has increased manifold. The use of technologies for teaching and learning has been broadly used as Educational Technology, which is the field concerned with the design, development, utilization, management, and evaluation of processes and resources for learning. The Association for Educational Communications and Technology (AECT) defined educational technology as "the study and ethical practice of facilitating learning and improving performance by creating, using, and managing appropriate technological processes and resources"¹. Historically the term educational technology has roots in audio-visual communication, systems approach, and educational technology as a process. In 1994, the AECT accepted 'educational technology' as synonymous with 'instructional technology'. We use the title of the course as Educational Communication Technologies to discuss the use of a variety of technologies for educational communication purpose. We would like you to have an overview of the field, and we are sure your engagements in the course would lead to your further exploration of the field through reading further literature given as references in the units throughout the course.

Course Objectives

At the end of the course, you are expected to be able to:

- Critically examine the process of educational communication to plan, design and use appropriate communication technologies in context;
- Identify the range of educational communication technologies, and their relative strengths and weaknesses;
- Use educational communication technologies confidently to create digital content and deliver these through new information technologies;
- Discuss and explain the general trends in the developments and use of educational communication technologies at national and international level; and
- Create engaging, collaborative, reflective and authentic learning environments for delivery of education and training.

Though the course is theoretical in nature, it has a lot of practical components, and we expect you to use this course to develop skills of using the technologies discussed in the course. We expect you to develop independent learning abilities to use computers and other technical hardware to create learning resources and environments that are interesting, motivating and engaging to the learners. So, you may need access to computer and Internet at home, office or in a cybercafé to practice the ideas and skill related inputs given in the course.

¹ Januszewski, Alan & Molenda, Michael (2008) *Educational technology: A definition with commentary*, New York: Lawrence Erlbaum Associates, p.1

We have also develop a short but interesting **Portfolio** that will give you instruction on how to practice the skill component, and record the outcomes. The portfolio shall be considered as the assignment component of the course and it would be evaluated at your study centre. You will submit the Portfolio at the study centre for evaluation after completing the activities mentioned there. You may like to discuss these activities in the counselling sessions with the available counsellor, who is trained to guide you to accomplish the tasks of the course. He/she will evaluate your engagements in the course through what you present in the portfolio.

There are **Check Your Progress** questions spread over in the course, and we expect you to do these before you actually check for the feedback given at the end of the units. These are opportunity for you to assess your own progress. These are places where you take pause in reading, and think, do, write, discuss and compare your answer with that of the one given at the end. If you check the response before you actually do the task, it would be cheating yourself, and we are sure you will not prefer to do so. If your response is different than the one given in the feedback, we advise you to re-check your own conceptions and thinking about the question/issue and read the topic again.

You may also like to highlight such areas for discussion in the **Counselling** sessions. Your interaction in the counselling session would make it more meaningful and lively. Counselling sessions are also the time when you can meet other learners, and see the diverse nature of the learner profile. It is encouraging to meet people with diverse background reading same subject and discussing and sharing ideas discussed in the course. If your learning style is more towards discussion and interaction, I suggest you must attend the counselling session. Even if, you are shy and like to study on your own through the materials supplied, counselling sessions provide you information about further readings and appraise you of the latest developments in the field. There is so much to learn form others, who are also seriously engaged in learning the same subject. Personally, I have benefited a lot by attending the counselling sessions, when I studied through distance mode.

Beside the counselling sessions, there are other media materials, and services available in this course, and you may like to take advantages of these by attending the teleconference session/virtual class as and when conducted. You will receive information about special arrangements regarding this from time to time.

What is covered in this Block?

This is the first block of the course, and we expect you to have some basic understanding about the process of communication, communication technologies, networks, and pedagogic issues related to the use of communication technology. The other blocks of this course are more technical in nature, and therefore, we have tried to cover important issues in the beginning to highlight the importance of thinking about “instructional technologies before information technology”. The emphasis here is to have an overview of the communication technologies and network, but you should have clear vision about the instructional use of the technology vis-à-vis what you learned from the course on Instructional Design. We also discuss issues related to management of technology, innovation and change in this block, as we strongly believe that any sustainable implementation of technology in education is due to strategic planning and systematic

approach to implement change. In the last unit of this block, we discuss issues related to assessment of student learning using technology, and evaluation of technology for learning. While there is large number of studies showing 'no significant difference', evaluative research indicates to us that technology can be an effective tool to provide equitable learning experiences. We encourage you to think critically about the concepts and ideas discussed in this block, and try to apply these in your own context. When you are not working in an institution, assume an institutional situation, especially your last alma mater, and think how that institution might benefit from the ideas discussed or how they were performing/using these ideas. In such a manner, you will develop insights into the course, and in the process read more literature/works in the related fields.



UNIT 1 INTRODUCTION TO COMMUNICATION TECHNOLOGY

Structure

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- 1.2 Communication: The Concept
 - 1.2.1 Functions of Communication
 - 1.2.2 Means of Communication
 - 1.2.3 Process of Communication
 - 1.2.4 Types of Communication
 - 1.2.5 Barriers to Communication
- 1.3 Educational Communication
- 1.4 Media and Technology of Communication
 - 1.4.1 The Print Medium
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- 1.5 Using ICT for People with Disabilities
- 1.6 Let Us Sum Up
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1.0 INTRODUCTION

Communication is as old as human civilization. Early human beings used to communicate with fellow human beings for their survival. Although communication is a part of all living beings in some forms or others, it constitutes a vital process of social life of human beings. Right from childhood till the old age, the development of a human being largely depends upon the communication he/she is engaged in. Therefore, understanding the nature and process of communication has been of great interest to many disciplines such as linguistics, journalism, management sciences, commerce, business studies, political science, psychology, technology and education. In distance education, communication plays a significant role as both distance learners and distance teachers communicate with each other using a variety of communication technology. The present Unit will make an attempt to explain the concept of communication as a basic human process. We shall also discuss and explain the broader framework for the study of communication and the implications of communication in distance education. Moreover, the Unit will touch upon different media and technology for communication.

1.1 LEARNING OUTCOMES

After going through this unit, you are expected to be able to:

- *Define* the concept of communication;
- *Explain* the functions and process of communication; describe the barriers in the way of effective communication;
- *Describe* the different kinds of communication with examples of each;
- *Enumerate* educational communication as a system;

- *Explain* how communication takes place in distance education system;
- *Classify* media according to different authors;
- *List* the attributes of various educational media;
- *Compare* the print and non-print media in terms of their merits and limitations; and
- *explain* the use of ICT for people with disabilities.

1.2 COMMUNICATION: THE CONCEPT

Communication is defined in many different ways. Some explain it as an 'art' – something creative, while, others say it is a science – a learned behaviour/skill and partly a science as it involves certain learnable techniques and psychomotor skills. However, communication is better described as a science because it is based on certain principles that can be verified and used to make it effective. Our assumption here is that communication is a scientific study, which produces skilled communication practitioners. Thus, we shall study 'communication' as a science and seek a scientific explanation for the concept of communication.

In ordinary parlance, communication exchange of ideas between two persons. When we search for a scientific meaning of communication, it refers to the act of communication, transmission, or exchange of ideas, thoughts, views, opinions and information between the sender and the receiver. Although, most communication takes place through verbal means or spoken words, communication also happens through written words, sound, gestures and postures, pictures, diagrams, graphics, etc.

It is difficult to define communication through a single definition. Different people perceive it in different ways in the different contexts, provided by the various environments or surroundings where communication takes place. Starting from the sharing of meaning to persuading others to elicit the desired/intended responses, communication has been defined to suit situational purposes. We may agree that 'the search for the single definition of communication seems to be a futile quest'. At best we can define communication according to its components. There are three main components of communication: *the source, the channel, and the receiver*. From the source's point of view, communication is essentially persuasion, i.e., to assure you as a communicator that your communication has taken place, or that the desired outcomes are achieved. From the receiver's point of view, communication is a process to elicit the desired responses. As a source you would be happy if the receiver could behave in the way you intended him/her to behave. From the channel point of view, communication is a medium, a carrier of information from the source to the receiver and/or vice-versa. In other words, we can say that communication is defined in terms of the functions to be performed or the objectives to be achieved. According to Shanon and Weaver (1949) the primary concern of communication is to reproduce as faithfully as possible a message sent from one place to another place. On the basis of different explanations, Schramm (1973) defined communication as the functions of persuading, informing, teaching and entertaining people. Therefore, communication is a process by which people create and share information with one another in order to reach a common understanding (Rogers, 1986).

Communication is one of the most complicated human activities; it involves the use of biological systems, cognitive systems, and socio-psychological systems (Richey, 1986). As different sensory organs are involved in carrying information or messages from the source to the receiver, communication involves different biological system. In human cognitive structure, through

the process of communication, new information is acquired, assimilated and accommodated in the existing information. For example, a child knows the concept of animal. When she is introduced to a new animal, say Chinese Panda, the new information gets accommodated in the existing information in the cognitive structure. Therefore, communication uses the cognitive systems. Moreover, the messages or information exchanges through a communication process are generated in a socio-psychological context. For example, the concept of 'family' taught to tribal children is understood by them according to the socio-psychological context they are placed in.

1.2.1 Functions of Communication

On the basis of the explanation we have given in the preceding paragraphs, we conclude that communication involves individual as well as collective activities of sharing ideas, facts and information. Thus communication performs various socio-psychological functions. MacBride (1980) has discussed some functions of communication in a social system. The main functions are as follows:

- i) **Information:** Communication refers to collective storage and dissemination of information for wider utilization by people. In this way it enables people to participate in and take intelligent decisions on, any issues of social relevance. Information has been taken as a resource for development – socio-cultural and economic.
- ii) **Socialisation:** Communication helps individuals become active members of the society to which they belong. People learn social norms in order to live cohesively. Having access to a variety of information, individuals get opportunities to understand each other and appreciate other people's feeling, emotions, ideas and expectations in a social system.
- iii) **Motivation:** Motivation of the individual members of a society plays an important role for its development. Communication fosters the individual and community activities, and motivates the people to meet goals, which have been mutually agreed upon. Well-informed individuals take the initiative of social welfare.
- iv) **Education:** Dissemination of information enhances the individual's intellectual development and helps one acquire the skills and aptitude required to become a productive member of society. In this way, communication and education are two sides of the same coin. The quality of education depends on the quality of communication between society and its members.
- v) **Entertainment:** Entertainment and recreation are important means of making individuals and society healthy. People find enjoyment and entertainment through various communication activities, viz. dance, drama, sports, music, etc. These means of communication provide personal and collective enjoyment.

What we have given here is a brief account of the functions of communication. You may add a few more functions of communication based on your own experience. Now let us take a look at the means of communication.

1.2.2 Means of Communication

There are various tools and media which serve as means of communication among human being. Starting from the signs – the primitive means, to super computer-based-communication, there are various techniques, technologies and materials generally used to collect, produce, carry, receive, store,

retrieve and disseminate information. All human beings make use of one or the other means of communication depending upon their accessibility and effectiveness. We shall discuss some of the prominent means of communication in this sub-section. Since this is an issue that concerns everybody, we shall discuss the potential of each means of communication as well as its weaknesses.

- i) **Signs and sounds:** Since primitive times, human beings have been using simple signs for communication. Body language and other non-verbal languages, viz., facial expression, gestures, music, songs, drawings, paintings, etc. are in use in different societies. In the tribal societies these means of communication are used for a variety of purposes, despite their obvious limitations (MacBride, 1980). These means of communication became refined and their reach was extended to still larger uses with the passage of time.
- ii) **Language:** A number of languages and dialects are used for communication purposes all over the world. In India, there are 22 scheduled languages listed under the Eighth Schedule of the Constitution and over hundreds of dialects used for communication. Language plays an important role in communication in both the face-to-face situation and at a distance — at the national or the international levels. The use of language is an important factor in educational communication too. Problems arise as a large section of the people does not understand each other's language, and this hampers the effectiveness of communication among them.
- iii) **Postal system:** The postal system is the most vital network for point-to-point delivery of information. It serves as the focal point for communication at a distance throughout the world. You may be aware of the fact that most of the communications of open universities, including IGNOU, takes place through post only. The postal system is the most accepted means of communication in both developing and developed countries. India has one of the biggest, well-established and efficient postal services in the world, which makes it possible for us to reach each and every corner of the country.
- iv) **Telephone:** One of the interpersonal communication networks is the telephone system. No other media can match the telephone for direct and spontaneous communication (MacBride, 1980). The use of the telephone in education is not yet popular in India. The limited telephone network and the high costs, besides the lack of initiative on the part of the educators in the country, are the main handicaps in using the telephone extensively in distance education. The growth of telephone communication, however, has been quite rapid in our country in recent years, especially with the emergence and rapid proliferation of mobile telephony. As of April 2010, the total number of telephone subscribers in India was 638.05 million (including 601.22 million wireless and 36.83 million wire line connections) with an overall tele-density of 54.10%.
- v) **Mass media:** The invention of the printing press and the radio waves has revolutionized the communication system throughout the world. These means have increased the reach and effectiveness of communication. Textbooks, newspapers, radio and television broadcasts have stepped into the area of mass education. By overcoming geographic barriers, broadcasting is successfully transmitting information to an unlimited audience. It crosses the boundaries of countries. The innovations in communication technology have opened new horizons for communication.

- vi) **Satellites:** The satellite-based communication has opened new horizons for the transmission of information over long distances. Satellites have brought the entire world together. One can transmit or receive information from any part of the world in no time at all. Many countries have their own communication satellites. The satellites so far launched by India are largely used for various domestic purposes. Besides the television and radio broadcasts, the Indian National Satellites (INSAT) are capable of providing facilities for the meteorological data, telephone networking, remote sensing, etc. In 2004, India launched a dedicated satellite for education.
- vii) **Computers:** The computers are the most advanced and sophisticated means of communication. They are a force in education, as they perform a number of functions with complete efficiency. They have made communication more interactive and individualized, especially because of the email and the web. We will study more about these in Block 4.

1.2.3 Process of Communication

Having discussed the concept, functions and means of communication, let us now discuss another important theme – the process of communication. The process of communication most widely accepted is that of Shannon and Weaver (1949), which identifies five elements in the process, viz, the source, the receiver, the channel, a coding system and noise. The Process of communication is the method by which a sender reaches a receiver with a message. There are basically four major steps involved in the communication process. A schematic representation of these steps is presented in Figure 1.1.

Sender: The source, or sender, is the originator of a message (see Figure). The communicator need not be a person; a memorandum, newspaper, professional journal, or organizational position such as the office of the principal, may be the source. The effectiveness of a message depends on the level of credibility that the receiver attributes to the sender.

Idea: The sender must create an idea or choose a fact to communicate. The idea or fact is the content of the message. In other words, the source must have something to say before the content can be “said”.

Encoding: The source initiates a message by encoding a thought, that is, organizing an idea into a series of symbols such as words or pictures that he or she feels will communicate the correct meaning to the intended receiver. The sender selects a particular medium because encoding must be done in relation to transmitting medium as well as the receiver’s characteristics. A telegram, for instance, usually is worded differently from an office memo, and both are different from face-to-face conversation.

Conceptual Filters: The conceptual filters of the sender, that is, the person’s particular psychological characteristics, also limit the encoding process. Communication skill, knowledge of the subject, and personality factors such as attitudes, values interests, and motivational needs are traits or mental conditions that combine to limit, screen or filter what is encoded and the quality of the message.

Transmitting: Transmitting transforms the encoded message into a signal and places it into a channel. The symbols that have been ordered inside a person’s mind are placed into physical movement. Transmitting therefore, involves the message, channel, and medium.

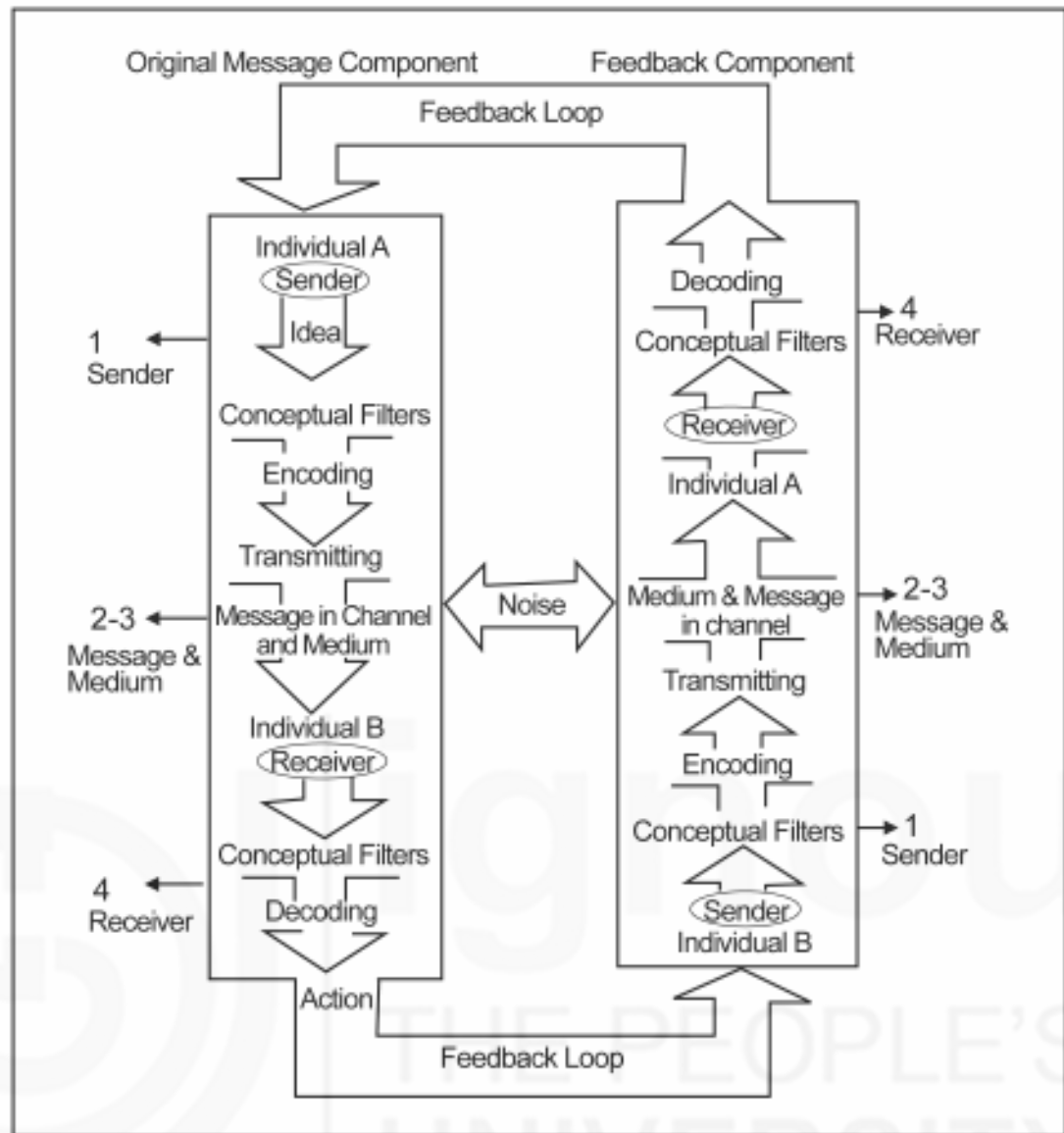


Figure 1.1: Communication Process

Source: Hoy & Miskel (1991). Quoted in IGNOU (2000)

Message: The message is the idea that an individual hopes to communicate to the intended receiver. The exact form of the message depends to a large extent on the channel and medium used to carry it.

Channel: The channel is the routing pattern that the message has to follow. The idea becomes a physical reality in the channel as opposed to a psychological reality in the sender's mind.

Medium: The medium is the carrier of the message. The content can be transmitted in a verbal-oral medium as in direct face-to-face speech, or electronically via telephone, computer, radio or television. Similarly, the medium can be verbal-written as in memos, letters, electronic mail, and newspapers. The transmission also can be made through non-verbal medium as in body language or gestures and symbolically with things that surround us such as office furnishings, clothes, etc.

Receiver: Internal processes similar to those in the source also occur in the receiver. The physical stimulus is taken from the channel by the receiver's sensory organs, ordinarily the eyes and ears and is sent to the mental decoder, where the receiver gives meaning to the message. If the listener is effective, the meaning is well understood. If the receiver does not function, the message is lost.

As is the case with the sender, no receiver can totally ignore his/ her psychological characteristics or conceptual filters.

Feedback: In broadest sense, this concept refers to any response from someone who has received a message. More specially, feedback is defined as messages conveyed to a receiver about task performance. The feedback loop provides two-way communication. Two-way communication is a reciprocal process; each participant initiates and receives messages. Each is a source or receiver only temporarily, with roles shifting as messages are passed. The use of feedback improves the communication process by reducing the chance of major disparities between information or idea received and the one intended.

Noise: Noise is any distraction that interferes with sending or receiving the message. Successful message transmission presumes that whatever situational noise exists is not great enough to observe the signal or divert the receiver's attention from it.

Check Your Progress 1.1

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

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

Define the following terms, in two lines each.

1) Channel

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.....

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.....

2) Code

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.....

3) Noise

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1.2.4 Types of Communication

Communication can be discussed at four levels, which are:

- Interpersonal communication
- Group communication
- Organisational communication
- Mass communication

Interpersonal communication: Interpersonal communication includes conversation between two persons. This is a common type of communication, in which two persons share their feelings, emotions, thoughts, ideas, etc. Interaction between two friends, between teacher and students, between mother and child and the like are a few examples of interpersonal communication. Talking on the telephone to someone is yet another example of interpersonal communication at a distance.

Group communication: In this type of communication, the members of a groups interact with each other. A group is a collectivity of people who have common interests. Discussions in a workshop, a seminar, or a family are examples of group communication. Group communication is used to take a collective decision on a problem, an issue or a matter of common concern. The participants involved in a group communication take active part in communication to achieve a set of goals, to develop social contacts or to find the solution to a problem faced by the group. Group communication is represented diagrammatically in Figure 1.2. The family, section in an office, and a classroom are examples of group communication systems.

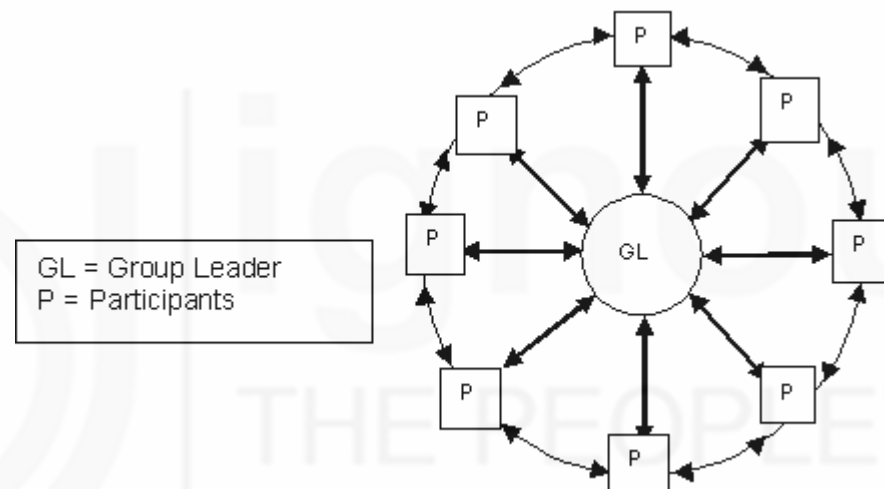


Figure 1.2: Group Communication

Organisational communication: It is that communication which revolves around one organization. Since an organization consists of groups of individuals, it can be said to be multiple group communication system having interaction among each other. Communication may start from any point in the organization, but the immediate ways of the information is only within the organization. Notifications are normally used as means of communication in such organizational communication system.

Mass Communication: Mass communication involves more than two people but it is beyond group and organizational communication. As the term 'mass' indicates, this type of communication includes ideas, thoughts, etc. communicated to a large number of people using mass media. In mass communication we include face-to-face, as well as, print and non-print communication. For example, the radio and television programmes are broadcast to educate, inform or entertain a large number of people.

Mass communication has three characteristics. We discuss them briefly here:

- i) **The audience is large and heterogeneous.** You know that radio and television, being mass communication media, have a large audience with different backgrounds, tastes, ages, occupations, etc. Both the illiterate and the literate can make use of these media. The newspapers, another mass medium, have a comparatively smaller audience.

- ii) *The source is an institution or a group of people.* For example, the Ministry of Information and Broadcasting, Government of India, is engaged in broadcasting television and radio programmes all over the country. The Times of India group is one of the private institutions engaged in printed mass communication in India. Similarly, IGNOU is engaged in creating and disseminating knowledge to a large number of students throughout the country, and it is an example of a mass education institution.
- iii) *Some kind of mechanism is used to reproduce information.* The mechanism could be the printing press, programme production studio, transmitters, the TV and the radio receivers, the Internet, World Wide Web (WWW), etc.

1.2.5 Barriers to Communication

There are various stages through which a message has to pass through from the source to the receiver(s) and vice-versa. These cause a number of interruptions and distortions in the way of effective communication. Sillars (1988) discusses two types of barriers that usually distort the flow of communication, and these are discussed below.

Barriers caused by the senders and receivers: The act of communication is broken down by the senders and the receivers themselves. The reasons may be a lack of understanding between each other, poorly defined objectives, failure to comprehend the language used, etc., or both the sender and the receiver may not be clear about what to communicate.

The receiver may not perceive the message as intended by the source (communicator). Similarly, defensiveness, permanency of attitude, situational misunderstanding, unfounded certainty, etc. are forces that can lessen the effectiveness of communication among the participants.

The individual's background and experience also influences the effectiveness of communication. Personality characteristics – aptitude, attitude, interest, motivation, etc. can interrupt the smooth flow of information. Similarly, hidden distracters, such as tension, frustration, anxiety, etc. among students can also lessen the effectiveness of educational communication. You, as a source, cannot force a student, as a receiver, to learn unless he or she is mentally ready to receive educational messages or has the necessary pre – requisites and study skills to grasp it.

At times, it is difficult to avoid barriers created by the source and the receiver. To overcome such barriers, we need to take special care at the stage of planning and developing the instructional materials. Use of different teaching arrangements (for instance, the print materials supported by the audio – video programme) can be used to bypass or overcome some of the distracting barriers. The use of language that is understood easily by the sender and the receiver may facilitate sharing the content.

As mentioned earlier, selection of the wrong medium may be disastrous for getting the message across. For example, if you want to discuss minor details of a system or, more specifically, if you want to discuss the flow of blood in the human body, the audio medium may not be as effective as the visual medium. So the use of appropriate medium can make communication effective and efficient. Similarly, choosing an unsuitable time for effectiveness of communication may be enhanced if the timings of communication are appropriate.

Barriers caused by the external factors: There are certain external factors that can disrupt the flow of communication. Any type of 'noise', such as, physical noise caused by the plying of vehicles, the sound of a type – write, conflicting messages, poor printing impressions, poor reception of the sender and the receiver.

One of the barriers of effective communication is indifferent behaviour and lack of sufficient motivation (of course, due to some internal or external factors) on the part of the receiver(s). The participants may not be ready to receive information and willing to actively participate in its transaction.

The domestic or social problems faced by a student may cause him/her to be less attentive than he/she might otherwise be. Similarly, lack of incentives, such as poor employment opportunities after passing a course may make communication defunct.

There are certain technical interruptions which create a lot of distortion in the communication process. Poor maintenance of equipment, substandard tools, defective receiving sets, weak transmission waves, etc. inhibits effective communication. The interference of some of the barriers can be reduced to a large extent if the sender/source understands the models or theories underlying the process of communication. We shall discuss some such measures as follows:

- i) Both the parties involved should know that communication needs to be attended to. Both should take initiative in sharing information.
- ii) Both the parties should recognize each others communication signals, i.e. they should understand each other's language. Both should work at the same wavelength.
- iii) Both the parties should be capable of thinking and feeling in somewhat similar ways. They should understand each other's message correctly; otherwise, they will not understand each other.
- iv) Both the parties should engage jointly in a purposeful communication act. Comprehension of message is not enough in itself. For communication to succeed there must be an outcome; the participants should display the communication specific intended behaviour. Information must be successfully shared so that a tangible outcome can be displayed.

Check Your Progress 1.2

Notes: a) Write your answers in the space provided.

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

- 1) Write two educational implications of interpersonal communication.

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- 2) Give at least one example each of different types of communication.

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1.3 EDUCATIONAL COMMUNICATION

The word 'communication' came from the Latin word 'communicare', meaning 'to share'. The act of teaching and learning is also an act of sharing the content, the skills and the attitudes. Thus, education can be seen a communication process between society and individuals (Hills, 1986). Hills further elaborates that education should be looked at constantly in order to determine how well it is communicating the norms of society. In other words, educational communication concerns itself with the process of how the teachers and students act and interact to enhance the knowledge, and the messages related to the curriculum (the content, the skills and the attitudes and related activities which educate, inform, train, enlighten, inspire and entertain the students). The receivers are the students and various teaching strategies such as demonstrations, tutorials, textbooks, assignments, audio-visual components, libraries, etc. are used as media to transfer the contents.

With the advancement in communication technologies, it is now possible to impart education throughout the world via satellites, which have the potential to communicate even live events to the students at their work-place. Thus, education has crossed many barriers of space and time. As a consequence, the methods of teaching and learning have also changed. Technologies such as computers, video-tapes, video discs, teletexts, communication satellites and teleconferencing services have stepped in to improve the nature of educational communication. These technologies have made the teaching learning process more lively and interactive. They have enhanced the pace of learning and also improved the means of retention and retrieval of information. Interestingly Hills (1986) regards the computer as man's fourth brain', taking its place alongside the other three – cerebrum, optic lobes and cerebellum.

Let us take the example of the Shannon and Weaver (1949) model of communication, and discuss its application to educational communication. In this model, the source of information is the teacher or the educational institution, i.e., the agency which intends to transmit knowledge, skills, values and culture to the future generations. The teachers supply and manage information in a way so as to make it understood by the students. The teachers make their ideas visible by coding them in a series of symbols in the form of spoken or written words, or visual signals.

As there are various channels of communication used in education these days, the main question in selecting the appropriate channel of communication is whether it clearly and accurately communicates with the students as desired by the source (the teacher or educational institution). The teachers have a variety of audio-visual media, viz., broadcast, audio/video cassettes, computers, teletext, teleconferencing, etc., which can be exploited to achieve the desired objectives at a faster pace and for larger student bodies.

The important point is that information should reach the students without any distortion. There are many sources of noise, which can reduce the effectiveness of the teaching and learning process. The interruptions (noise) in the way of communication should be removed. The biggest potential source of noise in distance education is the reading material that constitutes the master medium. The reading materials need to be prepared with clear objectives, to be written in simple language and be presented in a logical sequence. The materials should be self-explanatory, self-directed, self-contained and self-evaluating.

As mentioned earlier, the students should receive the information that is intended by the teacher or distance education institution. For this, they should possess the minimum pre-requisite of knowledge and skills to comprehend the message, undertake notes, answer the self-assessment questions and work on the prior knowledge possessed by the students. In other words, the course materials should be based on the background or prerequisite knowledge of the target students.

Feedback plays an important role in improving the quality of the course materials and achieving the desired objectives. The teacher should get information about how his/her materials/units, audio or video programmes are being received and assimilated by the students. Such information will make communication more effective and will eliminate errors in decoding and the problems caused by 'noise' in the entire teaching/learning process. On the other hand, the students should also get feedback on their progress of comprehension of the content discussed. Feedback about their performance will motivate the students to draw more from the learning materials.

Tiffin and Rajasingham (1995) discusses education as a communication system, which is purposive, receives certain inputs like students, teachers, knowledge, problem, and processes them at different communication levels so that the learners become knowledgeable to apply learned skills and knowledge to given problems. Education as a communication system also shares the characteristics of an open system, viz. negative entropy, feedback, steady state, differentiation, equifinality, teleology and hierarchy. Let us discuss these concepts in order to understand and apply them to distance education.

- i) **Negative-entropy:** Open systems resist the trend towards disorder and more towards increased organisation. For this purpose, they depend on feedback system and the environmental supra system.
- ii) **Feedback:** Feedback is a special input about the system and its environmental conditions; and about its functioning. This enables the system to take corrective steps to adjust its malfunctioning, if there is any.
- iii) **Steady state:** It is a condition of dynamic equilibrium, in which the system maintains its structure as stable, despite fluctuation in environmental condition.
- iv) **Differentiation:** Open systems not only adapt to changing environment, but also move in the direction of higher level of organisation or growth. Growth leads to differentiation of functions and to specialisation.
- v) **Equifinality:** It is the ability of open systems to reach a given state or condition by several different paths. Because of their inherent resilience and capability to adjust in changing environmental open systems arrive at a given desired state through various alternative methods.
- vi) **Teleology:** It is a characteristic of open system that indicates the purposefulness of the system and works according to its objectives.
- vii) **Hierarchy:** Open systems are hierarchical, that is, they are both independent framework consisting of a number of integral lower level sub-systems, and each one is a dependent member of the higher level system.

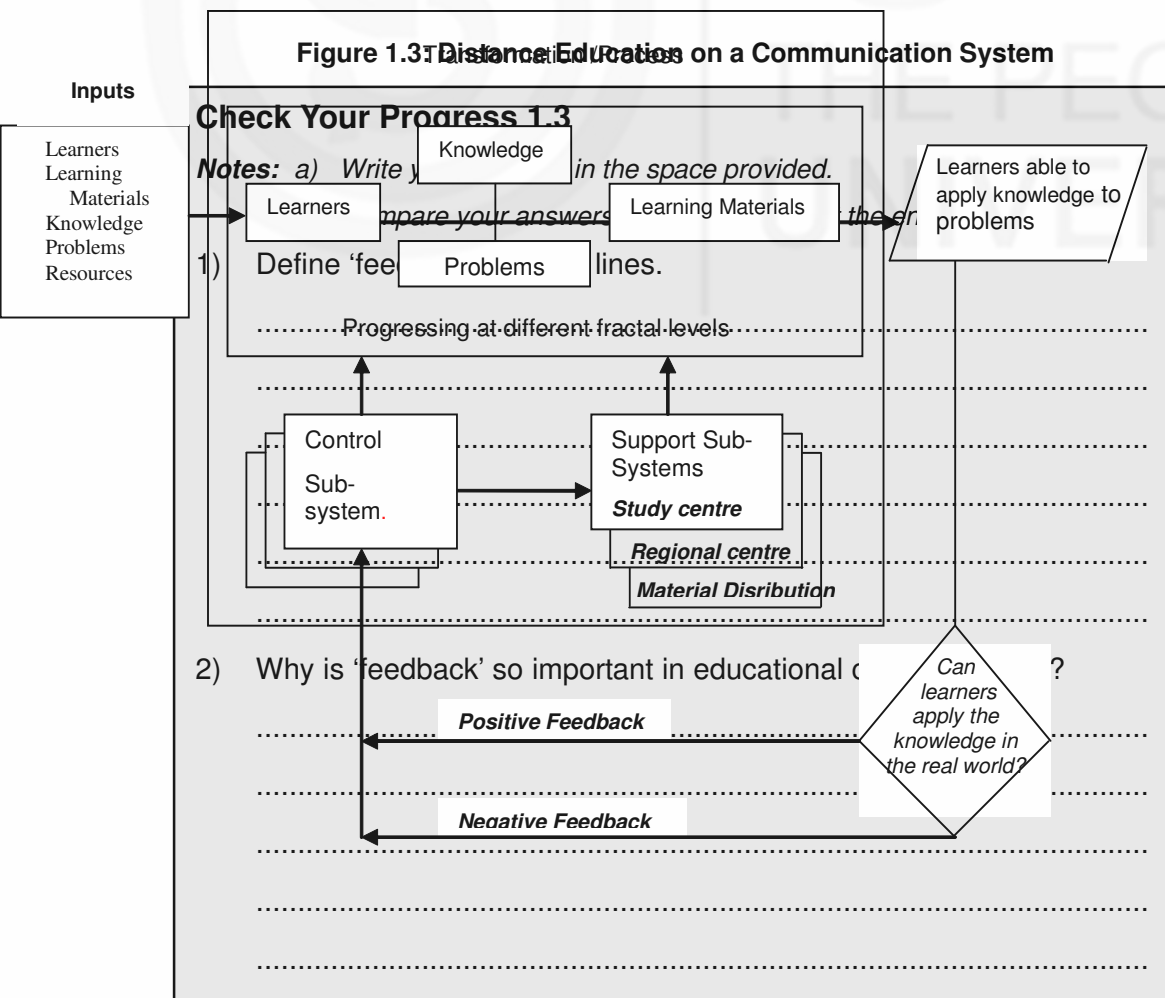
All these characteristics can be easily applied to education as a communication system. Figure 1.3 depicts distance education as a communication system having the characters of an open system. Processing at different fractal levels in the figure indicates the communication types. Support sub-system in distance education includes, study centre, regional

centre, material distribution system, etc. The control sub-system includes the Instructional Design (ID) and administrative sub-system that looks after the system in general.

Transformation/Process

Outputs

Learners
Learning
Materials
Knowledge
Problems
Resources



1.3.1 Communication in Distance Education

Distance education, as you know, is an act of sharing content and learning experiences, with students at a distance through a wide range of communication technologies. In distance education, the act of communication is performed through self-directed learning by arranging various teaching-learning environments. A distance teacher, unlike a face-to-face teacher, communicates with the students through different communication media. These communication media include self-learning print materials, face-to-face counseling or tutorials, assignments, audio-video programme, telecast, broadcast, Interactive Radio counseling (IRC), teleconferencing, E-mail, CD-ROMs, Internet, computer conferencing, mobile etc. The communication process in distance education system is depicted in the Figure 1.4.

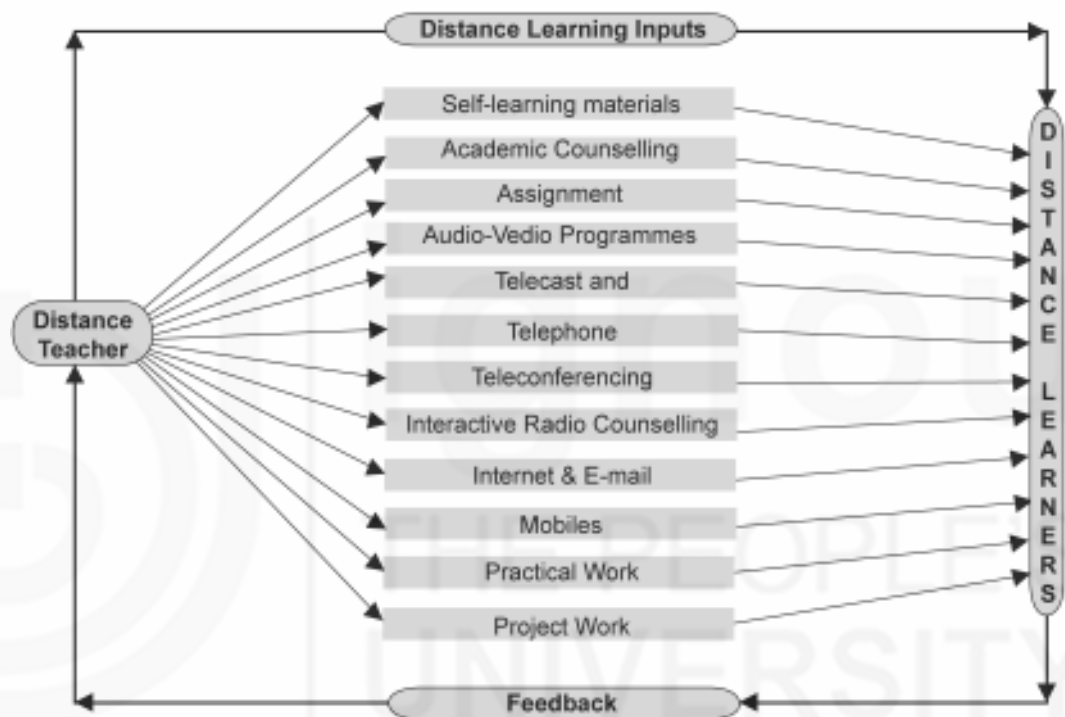


Figure 1.4: Communication in Distance Education

Print material is the principal medium of communicating learning experiences to the distance learners. Print materials in the form of self-learning units should be self-explanatory, self-directed, self-contained, self-motivating and self-evaluating. The introduction to the units should be motivating and provide a bridge between the information existing in the learners and the new information to be acquired by the learners. The materials need to be written in simple language. There should not be any use of ambiguous terminologies, double negatives and passive voice in the materials. Illustrations, examples, diagrams and cartoons need to be provided to strengthen the understanding of the materials. Materials should be presented on a logical and sequential manner. All these aspects are very important for the optimum communication through print materials. But sometimes, the course writers do not write the materials as per the specifications given to them. They may use difficult language; do not illustrate concepts with examples; do not support their presentations with diagrams or provide complicated diagrams. All these contribute to poor communication between the learners and the teachers. Academic counselling

provides distance learners a platform to communicate with teachers on a face-to-face basis. The success of communication during academic counselling depends on how well the learners and counsellors have made preparation for the counselling session. For example, a student does not understand a concept in a particular course and asks the counsellor to explain it. But, the counsellor has not gone through the materials before coming to the counselling sessions, and then he/she may not be in a position to communicate properly.

Assignments constitute a powerful medium of communication in distance education. Academic counsellors provide different types of comments on the performance of students in the assignments. These comments are helpful to student for improving their performance. But sometimes, academic counsellors do not provide any comments on the assignment response as a result there is no communication between the academic counsellors and the distance learners.

Effective communication can take place through audio programmes provided the script, narration, music are properly ensured. Similarly, good script, narration, visuals, music and overall editing of the video programmes enhance communication between the distance teacher and the distance learners.

Tele-conferencing has been proved to be a powerful communication medium in distance education system. Through audio-conferencing, the distance learners can interact with distance teachers and get to know many things pertaining to the academic programmes they intend to pursue. Even various contents can be taught to the students through audio-conferencing. Video conferencing — both one way video and two way audio, and two-way audio and two-way video is effective medium of communication. But in order that teleconferencing sessions are effective, proper pedagogic design has to be done beforehand.

Internet has come as a boon to facilitate effective communication in distance education. Through e-mail, students can know details about their programmes, information regarding the examination schedule, their results, grade sheet, etc.

Similarly, mobile technology has become a very convenient tool of communication between the distance teacher and the learners. Students also interact with distance teachers through interactive radio counselling, during practical activities, workshop activities and project work.

To communicate with the students at a distance is more difficult than with those who study in a face-to-face situation. There are several barriers between the distance education institutions and the students learning at a distance. For example, there is no provision, in most cases, for immediate feedback from either side. Most of the students and teachers do not know each other. In such a situation where you do not know much about your students, you have to be extra careful to ensure effective communication to achieve the educational objectives or bring about the desired changes in their behaviour. So, whatever medium is used, communication should reach the receiver(s) successfully.

Check Your Progress 1.4

Notes: a) Write your answers in the space provided.

b) Compare your answer with the one given at the end of this unit.

Write a short note on 'communication in distance education' in about 100 words.

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1.4 MEDIA AND TECHNOLOGY OF COMMUNICATION

It has been said that the various kinds of media are extensions of man. All modes of communication would be examples of media (for example, letters, television, films, communication, roads and railways). Educational media are, therefore, extensions for the teachers, and facilitate the communication between the teacher and the students. The media (in the Distance Education context) constitute an integral part of the process of planned instruction. We know that distance education has four essential characteristics: (i) the learners and the teachers are at a distance from each other; (ii) most of the educational content it conveys to learners are through one or more media e.g. print, television, radio etc.; (iii) a professional agency is responsible for the programmes; and (iv) the instructional system provides for two-way communication between the learner and the teacher, the tutor or the administrator. Thus educational media are carriers of educational information and instructional material over a distance between the tutor of distance education institution and the learners.

1.4.1 Classification of Communication Media

Communication media include the various instructional aids that are used in the instructional process. These can be classified according to the senses they stimulate and the messages they transmit.

The above classification of communication media provides a clear and comprehensive picture of different instructional aids which could be used by teachers. By and large, the non-projected aids are used by most of the teachers because of their availability in educational institutions and ease of handling them. However, now-a-days, most of the educational institutions are gradually being equipped with more advanced communication media.

- i) Audio
 - a) Voice (any human sender of the message)
 - b) Gramophone records
 - c) Audio tapes, to be used in a tape-recorder or language laboratory
 - d) Stereo records/ tapes
 - e) Radio
 - f) Telephonic conversations.
- ii) Visual (Verbal) print or duplicated
 - a) Textbooks, supplementary books
 - b) Reference books, encyclopaedia, etc
 - c) Magazines, newspapers, etc.
 - d) Documents, clippings from published material
 - e) Duplicated written material
- iii) Visual (non-projected, two dimensional)
 - a) Messages/ pictures on roll-up board
 - b) Flat pictures, cut-outs
 - c) Posters, charts, graphs, etc.
 - d) Cartoons, comics, etc.
- iv) Visual (non-projected, three-dimensional)
 - a) Models, mock-ups, display materials
 - b) Diagrams
 - c) Globes or maps (three-dimensional)
 - d) Specimens (animate or inanimate)
 - e) Puppets
- v) Visual (projected-still)
 - a) Slides
 - b) Film strips
 - c) Overhead transparencies
 - d) Micro image system: micro film, micro card, micro fiche
- vi) Audio-visual (projected-motion)
 - a) Film
 - b) Television
 - c) Close-circuit television
 - d) Video cassettes
- vii) Multi-media packages (for more than one sense)
 - a) Slide + tape + workbook
 - b) Slide + tape + workbook
 - c) Radio + slide or posters (Radio vision)
 - d) Film + posters + workbook (print materials)
 - e) Television + workbook (print materials)
 - f) Any of the above + group discussion
 - g) Any of the above+ introductory and summarizing talk by teacher/ leader of the group
- viii) New emerging media (all of these are multisensory)
 - a) Tele-conferencing (group discussion through telephones)
 - b) Cable television (localized television where feedback is possible)
 - c) Satellite television/ communication satellites
 - d) Computer networking
 - e) Video discs
 - f) Mini computers/ micro computers/ word processors.

Source: Kulkarni (1986)

Various media experts have proposed taxonomies of educational media. Romiszowski (1974) developed his taxonomy on the basis of sensory channels used in carrying information. His media classification is shown in Table 1.1.

Table 1.1: Romiszowski's classification of educational media

Sensory Channels	Major Illustrative Media
Audio	Teacher's voice, language laboratory, audio tapes, radio broadcasts etc;
Visual	Pictures, charts, models, handouts, film slides, transparencies, programmed instructional material etc.;
Audio-Visual	Open channel television, closed circuit television, videotape, etc.;
Tactile	Working models, simulated devices, adaptive teaching machines etc.

Romiszowski's classification is based on a single criterion i.e the sensory channels used in receiving information. It is, therefore, considered quite inadequate. Schramm (1977) proposed a two-tier classification of educational media i.e. big media and small media. According to Schramm, big media are "the glamour boys of the field" and they are more expensive and based on new technologies. Small media, on the other hand, are relatively much cheaper and based on early and intermediate technologies. Television, sound film, computer and interactive video are some examples of big media; transparencies, slides, various types of boards represent small media.

However, Bretz (1971) has developed the most comprehensive taxonomy of educational media and it has found acceptance among most media experts. Bretz's media taxonomy is based on two criteria i.e. the type of information they communicate and whether they are primarily recording media or telecommunication media. Bretz divides information as *audio* or *visual* and *still* or *motion*. He further sub-classifies the visual sector as comprising picture, line graphic and print. Picture and print are the two extremes of the visual continuum; line graphics occupy the middle position. Bretz initially subdivided the audio sector into four categories viz.; the human voice, natural or artificial sounds, noise and music. However, he treated the audio sector as one whole and did not subdivide it. In other words Bretz divided educational media into seven classes.

They are listed below:

- Class I : Audio-motion-visual media
- Class II : Audio-still-visual media
- Class III : Audio-semi motion media
- Class IV : Motion-visual media
- Class V : Still-visual media
- Class VI : Audio-medium
- Class VII : Print medium

Various classes of media have different capabilities to carry different types of information. For example, Class I media is the most versatile and powerful because they can record and transit all types of information. Class VII media have the most restricted capability.

Bretz's classification is based on quantitative as well as qualitative principles of valuation. However, the greater versatility of Class V media compared to that of class VI media compared to that of class VI media is superficial because of the sub-classification of the visual sector. Had Bretz subclassified the audio sector, then the differences between these two classes would have more or less disappeared. Lastly, Bretz describes his taxonomy in terms of hardware. The great variety of hardware available and being developed from time to time makes its complete listing almost impossible.

Having discussed Romiszowski's and Bretz's taxonomies of educational media, let us try to assimilate them into a simple classification/ grouping for better and easy understanding. Many educational technologists prefer to categorise media into basically two groups: interactive, and non-interactive. Within these two broad groups they put all educational media. From another point of view educational materials could be classified into five categories, viz. (i) print (ii) audio, (iii) video, (iv) 3-dmodels, and (v) integrated. Now, let us make a matrix of these five categories and the former two groups to classify the range of educational media available to us. Table 1.2 depicts the simple classification based on this matrix.

Table 1.2: A Simple classification of educational media

Media	Non-interactive media	Interactive media
Print (Text/ graphics)	Textbooks, Pictures, charts SIM (interactive partially), Teletext	
Audio	Audio tape, Radio, Audio vision (partially interactive)	Radio-phone in Audio conferencing, Audiographics Telephone
Video	Videotape, Television, Cable T.V.	Interactive TV, Video teleconferencing (one way/ two-way audio)
3-D models	Physical objects, models, Home Kits	Computer generated 3D models
Integrated	Radiotext, Word Processing and Presentational software, WWW (partially non-interactive)	Computer based media Interactive Multimedia Internet, WWW, Videotext

1.4.2 The Print Medium

It is common knowledge that 'print' has been in use as a pedagogic medium for quite a few centuries; it was used even before the first mechanical printing press was set up by Johannes Guttenberg in Germany. It has been the major if not the sole medium of formal face-to-face education. Recent studies have revealed that even in distance education, print continues to be used as the most dominant medium. Dichanz (1982) in his "Reflections on the Use of Media in Distance Education" stated that in West Germany, 90% of all study materials at the Fern-Universitat are printed materials and that there is little variety in the use of media. The U.K. Open University enjoys a good reputation for its innovative use of various educational media and Hawkrigde has this to say about the Open University: "Print is the principal medium through which Open University students learn. They spend about 90% per cent of their time reading and writing, except in some science and

technology courses for which the proportion may be some what lower on account of practical experimental work". In India too, the picture is more or less similar. All distance education institutions in India use print as their major educational medium.

Limitations of print medium

Like any other pedagogic medium, print too has its merits as well as limitations. Predominant use of print as an educational medium on a large scale can be attributed to two factors: i) its merits, and ii) its low cost vis-à-vis other media. Print is often described as "frozen language", absolutely cold, dead, unrelated to reality and totally cut off from the context of experience and therefore irrelevant. All the shortcomings of language are also attributed to 'print'. These are chiefly four:

- i) Language is a poor substitute for direct experience.
- ii) Language can be misleading and therefore it cannot be trusted.
- iii) We participate and live in an oral culture, so education through print is dispensable as well as undesirable.
- iv) Problem-solving calls for direct action, hence print cannot be a substitute of direct action.

Besides these ideological criticisms, there are some practical limitations as well.

- i) Print is a demanding educational medium because its effective use depends upon a reasonably adequate level of literacy among learners.
- ii) Print is effective only when the reader possesses well-developed cognitive skills for comprehending the text and evaluating its thought content.
- iii) Reading is a linear sequential process in which words as well as lines have to be processed in a certain sequence i.e. left-to-right, right-to-left or top-to-bottom. A visual image on the other hand can be processed as a whole and understood almost spontaneously. One just looks at it and understands its content depending upon his/ her power of observation.
- iv) Reading printed material is much more time-consuming than viewing the same content through images e.g. a TV programme.
- v) Reading is unsuited for developing skills, irrespective of whether these skills are interactive or managerial or psychomotor. Reading a printed lesson can provide theoretical information about how to drive a car but it cannot provide a person with the skills required for driving a car.
- vi) The language of the printed lesson is chosen according to the writer's assumption about average readers. Once written, the language of a printed lesson is fixed; it does not change for below-average or weak learners. Hence it is argued that print is not an appropriate pedagogic medium to do justice to learners of different abilities; usually weak learners and learners with reading disabilities are the worst sufferers.

Merits of print medium

These criticisms establish that even the most widely used pedagogic medium needs to be defended; however, defending it is not a difficult job. Print has certain merits that account for its widespread and universal use in all modes of education including the distance mode. Briefly put, 'print' has the following merits as an educational medium.

- i) Print provides relatively permanent instructional material that can be processed whenever one wants to.

- ii) Processing printed material takes more time and greater time devoted to the task ensures more and better learning.
- iii) Print allows the learners to learn at their own pace and in a style best suited to them because it gives them more options for selecting a better learning strategy or even initially trying out many strategies and choosing the most effective one. Thus print individualizes learning in a unique manner.
- iv) Use of print as an educational medium is in perfect consonance with our highly developed cultural ecology. In fact, all developed cultures are heavily print dependent. Education through imitation, demonstration and the oral word characterizes a primitive rather than an advance culture.
- v) Certain kinds of thinking involved in the process of education make the use of print medium almost inevitable. Defining, qualifying logical constraints, elaborating or sequencing complex reasoning necessities the use of print.
- vi) Abstract thinking involves the use of symbol systems and therefore print is uniquely suited to abstract thinking. As we move away from concrete of learning, use of language becomes indispensable and print assumes special importance.
- vii) Print remains the cheapest educational medium to use even today. It scores over almost all other media in terms of cost, portability and freedom from dependence on any hardware for its users.

Thus we can conclude that like all other educational media print has its strengths as well as weaknesses. Print is exceptionally useful for:

- Developing understanding of complex concepts and processes;
- Developing basic learning skills of reading and writing that help a learner become more and more autonomous; and
- Helping learners to take stock of their learning through interpolated questions (as is being done through self-check questions in these lessons); this enables the learners to review their learning and structure it properly by establishing linkages with preceding portions or lessons.

In fact we would do well to remember that even the big media such as computer and television technologies use print even if very briefly. Notwithstanding the merits of print medium, our focus in this unit is on non-print media as such. So, let's discuss these in the next sub-section.

Check Your Progress 1.5

Notes: a) Write your answers in the space provided.

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

- 1) Describe any three major shortcomings of "print medium".
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- 2) List any four features of the print medium that account for its wide spread use in education.
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1.4.3 The Non-print Media

The non-print media are loosely called the “electronic media” as well, but certain non-print media are not at all electronic e.g. 3-D models and home experiment kits. However, most of these are electronic based and they can, therefore, demolish distance in a unique manner. Let us first examine some of the merits that non-print media have in the context of distance education.

- i) **Greater delivery capabilities:** The non-print media, especially those in the electronic category, can simultaneously reach learners at different places and also give them a feeling of belonging, of being members of a large organization and thereby take care of their feeling of isolation, and the feeling that just because teachers do not teach them in face-to-face situations, they do not matter to the system.
- ii) **A supplement to the master medium:** We know the most DE institutions use print as their principal or master medium. The non-print media can provide excellent support to the print media because of their versatile capabilities. There are certain qualities that make educational media function as a good supplement. Portability, complete control over when to use it as well as over its functions, and possibility of its use by the individual against that by the group are a case in point. These features of the non-print media as means to supplement the master medium are clearly shown in Table below.

Table 1.3: Non-print media as a supplement: Criteria-based analysis

MEDIA	CRITERIA			
	Portability	Individualized use	Control over use	Control over functions
Television	Yes (portable models only)	Yes	No. TV Schedule pre-determined	No
Radio	Yes	Yes	No	No
Film	Yes (for portable models only)	Yes (though costly)	Yes	Yes
Photographs	Yes	Yes	Yes	Yes
Slides	Yes	Yes	Yes	Yes
Audio Tape	Yes	Yes	Yes	Yes
Video Tape	Yes	Yes	Yes	Yes
Computer	Yes (only for Notebooks)	Yes	Yes	Yes
Videodisc	Yes	Yes	Yes	Yes

- iii) **Greater suitability to iconic and enactive modes of experience:** Bruner has proposed a three-tier classification of experience: Enactive (involving activity), Iconic (using pictures, graphic or 3-D representations) and symbolic (based on the use of symbols). Print is suitable for symbolic experience. The non-print media can make educational experience more comprehensive. For example pure verbal description in print cannot teach a person how to tie even a simple knot, but silent, or sound films or videotape can convey this information most effectively. Similarly, work on home experiment kits can enable a student to master the use of various techniques through the enactive mode. Print is an ineffective medium for providing such learning experiences.

- iv) **Feedback through recorded performance:** Some non-print recording media can record the learner's performance and provide extremely useful feedback. For example, audio-tapes provide excellent feedback about one's mastery of the sound system of a language or video tapes provide much needed corrective feedback for other types of performance. Print medium is of little use in this respect.
- v) **Facilitate diverse learning objectives:** In distance teaching the instruction moves away from the conventional face-to-face teaching mode and a reasonable reliance on various other media becomes necessary to meet diverse learning objectives. Printed matter cannot meet all learning objectives very efficiently. William H. Allen's (1967) chart of presumed effectiveness of different instructional models are presented in Table 1.4 (quoted in Schramm, 1977):

Table 1.4: Instructional media in relation to learning objectives

Instructional media	Learning Factual Information	Learning Visual Identifications	Learning Principles, Concepts and Rules	Learning Procedures	Performing Skilled Perceptual Motor Acts	Developing Desirable Opinions & Motivations
Still Pictures	Medium	High	Medium	Medium	Low	Low
Motion Pictures	Medium	High	High	High	Medium	Medium
Television	Medium	Medium	High	Medium	Low	Medium
3-D Objects	Low	High	Low	Low	Low	Low
Audio-Recordings	Medium	Low	Low	Medium	Low	Medium
Programmed Instruction	Medium	Medium	Medium	High	Low	Medium
Demonstration	Low	Medium	Low	High	Medium	Medium
Printed Textbooks	Medium	Low	Medium	Medium	Low	Medium
Oral Presentation	Medium	Low	Medium	Medium	Low	Medium

- vi) **Contribute to specific learning activities:** Certain non-print media formats and delivery systems contribute particularly well to the distance student's learning activities. For example, audio-tapes or computers can be used effectively to drill and provide practice to learners in arithmetic and language learning. Electronic media can help promote the 'discovery' approach to learning. For example, a film can be exploited, for discovery teaching in the physical sciences. Students keep watching the various sections of the film until they perceive the relationships between the visuals. Then they are curious to find out the principles that explain those relationships. Likewise, in the social sciences various media types can be used to present learners with visual and auditory experiences that provide related information and questions. Films and simulations are often used to present 'real life' or 'laboratory learning' situations for inquiry into problems and discovery of their situations.
- vii) **Motivate learners psychologically:** The use of electronic media has proved psychologically exciting for students — both at the preparation and the participation stages and consequently it promotes learning. Several of the introductory functions, such as directing attention, arousing motivation, providing a rationale, etc., may be served by non-print media more effectively than by a printed text. Variety and newness of these media interest and motivate students to learn.

These media have the power to stimulate interest and appeal to the neo-literate while the print material turns out to be a stumbling block for such learners. For example, the experience of television shows that “the excitement of television sometimes leads participants in a project to undertake tasks they might otherwise hesitate to attempt” (Schramm, 1977: 171).

- viii) **Help learners get involved:** Many studies have emphasized how the non-print media achieve learner involvement and participation and thereby facilitate learning. Continuous active participation is lacking in learning at a distance through conventional texts where students’ response to the instructional stimuli and the reinforcement of correct response are delayed. Some electronic media lend themselves more to student participation than the print material. A study by May and Lumsdaine (1958) found that psychomotor skills are learned better if practiced while watching a film in which those skills are shown to have been found to facilitate learning. Even covert responses like silent repetition of key vocabulary and specified points in a lesson are found to be effective. A group discussion after the use of video cassette or film can also be used to enhance learning. Research by Kothari et al (2003) reveal that same language sub-title improves language literacy as it engages the audience.
- ix) **Promote participatory learning:** Moreover, electronic media directed instruction increases learners’ concentration on a task because teachers employing television for instruction have found that televised instruction receives more concentration and has fewer diversions than classroom instruction. Because instruction through media is structured, the objectives are clearly defined, and the instructional environment is created to achieve those objectives. Print material is also structured with clearly stated objectives. Print material is also structured with clearly stated objectives but fails to create the desired atmosphere. Non-print media help *provide a learning atmosphere in which students actively participate in the learning process.*
- x) **Accommodate individual needs:** Non-print media have the flexibility of accommodating individual needs and interests, especially through computers. The emergence of technological advances has coincided very well with the increasing awareness of individualized instruction. The variety and flexibility of new media offer the opportunity to adapt any media combination for use in individualized instruction. For example, programmed instructions or the system of audio tutorial instructions are specifically designed for individualized learning. Audio tutorial relies on audio recording to individually guide students’ learning activities. Through individualized instruction, it is possible to treat groups of students to suit the common characteristics they exhibit. For example, students with disability, who have particular needs, get special instructional treatment. In this way we can best adjust instruction to the characteristics of any given group of students. Adjusting instruction to these special groups requires a heavy reliance on technically developed media and materials and the appropriate selection of those materials to meet the specific needs.
- xi) **Help learners monitor the information input:** Some technological devices like audio cassettes and video cassettes allow the learners the freedom to choose how much information they would like to be exposed to. They also allow the freedom to listen to and/ or view the whole/ part of an information pack as many times as they would like to. Besides, these technologies also enable them to choose their own convenient time to receive any given information.

- xii) **Extend the role of a teacher:** With the use of non-print media, the role of a teacher extends further than merely being a dispenser of information. Media utilization permits teachers to become creative managers of the learning experience. They can find more time to spend on diagnosing students' problems, holding consultations individually, and offering counsel and guidance.

Check Your Progress 1.6

Notes: a) Write your answers in the space provided.

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

- 1) Briefly describe how non-print media can supplement the print-medium.

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- 2) Describe three pedagogic uses of non-print media, which are unique to them.

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1.5 TECHNOLOGY FOR PEOPLE WITH DISABILITIES

The most important application of any technology is to make life easy, and who needs this more than the people with disabilities? We are falling behind in providing necessary assistance (communication or education) to the deaf, physically or the visually disabled. There are millions of people in the developing world, who require special and improvised communication technology.

Classification of Disabilities

We can categorize disabilities into primarily four groups:

- Related to vision: people with near or complete blindness; low vision; and colour blindness.
- Related to Hearing: people with difficulty in hearing; and deaf.
- Related to Mobility: people with physical problems due to paralysis, polio, and loss of limb.
- Related to Cognition: people with lack of processing capabilities in the brain such as lack of short-term memory; and learning disabilities.

It is generally a difficult task to prepare digital learning resources that can be accessible to all the above groups of people, as the design needs are different. Nevertheless, today, it is possible to provide equivalent learning resources in alternative formats to people with disabilities with the help of Assistive Technologies (AT).

Assistive Technologies

AT is a generic term used to describe any device or system that helps disable people to live, learn, work, and enjoy life. AT makes it possible for people with disability to do more for themselves and change some of the functions that were previously difficult because of impairment. AT allows independence and empowers disabled individuals and brings in equality. Some of the assistive technologies (IMS, 2002) applicable in educational institutions with particular reference to the digital technologies are given below:

- **Screen Readers** are software products designed for blind people. A screen reader transforms a graphic user interface into an audio interface.
- **Voice Recognition Softwares** allow people to give commands and input data to a computer by speaking. These software use a microphone and are generally useful for people who have difficulty in typing using their hands.
- **Speech Synthesizers** are text to speech programs that read and speak aloud textual materials on computers.
- **Screen Magnifiers** are software solutions for blind people with low vision, and work like a magnifying glass. They enlarge the text displayed on screen and also have capabilities to change colours.
- **Braille Embossers** transfer computer generated texts into embossed Braille output.
- **Refreshable Braille Displays** are tactile devices that move small plastic/metal pins up and down to create Braille letters on a flat board. The user reads the Braille letters with his/her fingers. After a line is read, the display can be refreshed to read the next line.
- **Adaptive Keyboards** are designed for users with physical disabilities who can't use standard keyboards. These keyboards come in different size and/or alternative key configurations to suit one-hand use. For people who can use mouse, on-screen keyboard softwares are also available.

Table 1.5 matches the assistive technologies to different types of disabilities.

Table 1.5: Assistive technologies for the disabled

Disabilities	Assistive technologies
Visual Impairment	Screen readers, Screen enlargers, Speech recognition systems, Speech synthesizers, Refreshable Braille displays, Braille embossers
Hearing Impairment	No specific At, as these people can make use of computer well. It is said that deaf people can be good programmers.
Physical Impairment	Adaptive keyboards, Speech recognition systems, Speech synthesizers, Touch screens
Cognitive Impairment	Speech synthesizers, Speech recognition systems, Reading tools and Learning disability programs

Accessible Website Design

In the recent times, most of the educational institutions provide information about their activities through websites. Some even have attempted online courses and programmes often referred to as e-learning. A sophisticated institutional website is also considered as an indicator of the status and pride. But, most of these websites are completely inaccessible by people with

disability as these websites do not follow the web accessibility guidelines of the World Wide Web Consortium (W3C). In a recent study conducted in the USA covering top 50 nationally ranked Liberal Arts College and Universities, Irwin & Gerke (2004) revealed that only 3 had accessible home pages meeting Bobby (<http://www.cast.org>) level 1 access guidelines. It would be interesting to see how many of Indian websites are actually accessible to people with disability. Freed et al (2003) provide eight guidelines and 21 checkpoints to provide accessible software and websites. These are:

- 1) Provide access to image for users who are blind or visually impaired through text equivalents.
- 2) Provide access to multimedia presentations for users with sensory disabilities.
- 3) Provide access to forms for users who are blind or visually impaired.
- 4) Provide access to data in tables for blind users.
- 5) Provide access to textbooks.
- 6) Provide access to interactive activities for all users with disabilities.
- 7) Provide access to graphs for users who are blind or visually impaired.
- 8) Provide access to scientific and mathematical expressions for all users with disabilities.

1.6 LET US SUM UP

‘Communication’, as a scholarly field of study, is a science that produces skilled communication practitioners. It deals with the process of informing, motivating, teaching and entertaining people. It also involves creating and disseminating information, facts, ideas and feelings to its users. In this unit, we discussed that communication has manifold functions of which the main ones include informing, persuading, sharing, socializing, motivating, educating and entertaining people. These functions are carried out by various means of communication – signs, words, written language, postal services, the telephone, the radio, the television, the computers, etc.

There are six components of communication: i) the source and receiver, ii) the channel, iii) the symbol of code, iv) the noise, v) the feedback and vi) the context in which communication takes place. The effectiveness of each component contributes to the overall effectiveness of the communication process. There are various interfering variables, which distort the effectiveness of communication. The personality factors of the source and receiver, the choice of medium, the domestic and social problems, physical and technical disturbances, etc. are some of the prominent barriers to communication. These barriers can be overcome or reduced to a large extent, provided all the understanding between the source and the receiver does increase the effectiveness of communication.

We also discussed education as a communication process, and identified the media used in communication in distance education. We discussed the merits of non-print media at length to emphasize the advantages of various media and technologies used for teaching and learning. We also highlighted the need for accessible design of learning materials and resources to enable people with disabilities to have equal opportunity in learning.

1.7 KEYWORDS

Assistive technology: is a generic term used to describe any device or system that helps disable people to live, learn, work, and enjoy life.

Communication: is the art and science of persuading, informing, teaching and entertaining people. It involves a sender, a message, a receiver, a medium (channel), and feedback to complete the communication.

Equifinality: is a characteristic of an open system to reach the objective/goal of the system through a variety of means.

Teleology: is the study of purpose in a natural phenomenon. Open systems show the characteristics of purposefulness.

1.8 REFERENCES AND FURTHER READINGS

- Bretz, R. (1971). *A Taxonomy of Communication Media*, Englewood Cliffs, N.J.: Educational Technology Publications
- Dichanz, H. (1982). 'Reflections on the Use of Media in Distance Education', in *Learning at a Distance: A World Perspective*, Edmonton, Canada
- Freed, G., Rothberg, M., & Wlodkowski, T. (2003). *Making Educational Software and Websites Accessible: Design Guidelines including Math and Sciences Solutions*, Boston, MA: Media Access Group at WGBH, Available at <http://ncam.wgbh.org/cdrom/guidelines2000>
- Hills, P.J. (1986). *Teaching, Learning and Communication*, Croom Helm, London.
- Hoy, W.K., & Miskel, C.G. (1991). *Educational Administration: Theory, Research and Practice*, Now York: McGraw Hill.
- IGNOU 2000). Unit 4 Organizational Behaviour, in ES-335: Teacher and School, New Delhi: IGNOU
- IMS (2002). *IMS Guidelines for Developing Accessible Learning Applications*, Ver. 1 White Paper, <http://www.imsglobal.org>
- Irwin, M. M., & Gerke, J. D. (2004) Web-based information and prospective students with disabilities: A study of Liberal Arts College, *Educause Quarterly*, 27 (4), pp. 51-59
- Kothari, Brij, Takeda, Joe, Joshi, Ashok, & Pandey, Avinash (2003). "Chapter 13: Same Language Subtitling: A Butterfly for Literacy?". *Reading Beyond the Alphabet*. SAGE Publishing. pp. 213-229
- MacBride, S. (1980). *Many Voices, One World: Report by the International Commission for the Study of the Communication Problems*, Paris: UNESCO.
- May, Mark A. & Lumsdaine, Arthur A. (1958). *Learning from films*, Yale University Press, New Haven, Conn
- Mcquail, Denis, & Windahl, Sven (1981). *Communication Model*, Longman Group U.K. Ltd., London.
- Richey, R. (1986). *The Theoretical and Conceptual Bases of Institutional Design*, London: Kogan Page.
- Rogers, Everett M. (1986). *Communication Technology: The New Media in Society*, The Free Press, New York.
- Romiszowski, A.J. (1988). *The Selection and Use of Instructional Media*, Kogan Page, New York.
- Kulkarni, S.S. (1986). *Introduction to Educational Technology*, Bombay: Oxford & IBH Publishing Co. pp. 143-144.
- Schramm, W. (1973). *Men, Message and Media-A Look at Human Communication*, Harper & Row Publishers, New York
- Schramm, Wilbur (1977). *Big Media, Little Media*, California: Institute for Communication Research, Stanford University.

Shannon, C.E., & Weaver, W. (1949). *The Mathematical Theory of Communication*, Urban: University of Illinois Press.

Sillars, Stuart (1988). *Success in Communication*, John Murray (Publisher) Ltd., London.

Tiffin, John, & Rajasingham, Lalita (1995). *In search of the virtual class: Education in an information society*, Routledge, London.

1.9 FEEDBACK TO CHECK YOUR PROGRESS QUESTIONS

Check Your Progress 1.1

- 1) Channel: The means or medium through which communication takes place between the source and the receiver is called the channel.
- 2) Code: A Code is a set of symbols that create meaning for both the source and the receiver. For example a written or spoken word is a code.
- 3) Noise: The factors which disturb or prevent proper exchange of information between the source and the receiver are called noise.

Check Your Progress 1.2

- 1) The educational implications of interpersonal communication could be outlined as follows:
 - a) Personal contact programmes should be organised for distance learners.
 - b) Telephone and postal correspondence should be used.
 - c) Instructional materials should be directly addressed to the students.
 - d) Self-study groups should be formed.
 - e) Comments on the student assignment-responses should give the feeling that the student is, as it were, talking to the teacher and the peer group.
- 2) Examples of different types of Communication are as follows:

Intrapersonal communication	:	Reading a book
Interpersonal communication	:	Teacher and Student
Group communication	:	Class room
Organisational communication	:	School, offices
Mass communication	:	TV, Radio broadcast.

Check Your Progress 1.3

- 1) Feedback: Feedback is communication in response to a previous message. In other words, feedback refers to the process by which the sender and the receiver get information as to whether the information has been received and understood.
- 2) Your answer may, among other things include:
 - giving information on the progress of the student,
 - suggesting modifications in the content and approaches adopted in presenting the content,
 - telling whether the objectives of the course have been achieved, and to what extent,
 - facilitating pedagogic interaction between the teacher and the student, and thus motivate the student for learning, and
 - breaking the feeling of isolation among the students.

Check Your Progress 1.4

Communication in distance education takes place though the use of a variety of media. The student and teacher being at a distance, communication takes place through the use of printed text, audio, video, telephone, teleconference and other

face-to-face methods. Students are provided support through counselling at the study centres, where the learners and the tutor discuss the content of the course. The print materials also are prepared with special care to help the learner understand the concepts easily in an interactive manner. It is also told that in print material, the teacher is in-built. Assignments and feedback on assignment responses play a significant role in communication at a distance.

Check Your Progress 1.5

- 1) Four major shortcomings of print medium are:
 - a) it is unsuitable for affective and psychomotor objectives;
 - b) it is time-consuming because it has to be processed in a linear-sequential manner; and
 - c) its language is fixed and usually based on literary skills of average learners.
- 2) Four features of the print medium due to which it is widely used in education:
 - a) Cheapest medium even today.
 - b) Provides most for cognitive objectives and in some measure for affective and psychomotor objectives.
 - c) Can be used at any time and place.
 - d) Not dependent on any hardware.
 - e) Provides for more time to be spent on processing and therefore, results in more and better learning.
 - f) The only suitable medium for certain higher order cognitive skills. (Any four in any order).

Check Your Progress 1.6

- 1) Non-print media can supplement the print medium in areas and functions for which print is not best suited.
- 2) Three unique pedagogic uses of non-print are:
 - decrease in psychological isolation of learners and make them feel part of a large system.
 - introduce variety and heighten learner motivation.
 - ideally suited to presentation in enactive and economic modes of experience.

UNIT 2 COMMUNICATION NETWORKS

Structure

- 2.0 Introduction
- 2.1 Learning Outcomes
- 2.2 Development of Communication Technologies and Networks
- 2.3 Growth of Communication Technology
 - 2.3.1 Political Factors
 - 2.3.2 Economic Factors
 - 2.3.3 Cultural Factors
 - 2.3.4 Technological Factors
 - 2.3.5 Educational Factors
- 2.4 Communication Network Technologies
 - 2.4.1 Communication Satellite
 - 2.4.2 Computer Networks
 - 2.4.3 Wireless Networks
- 2.5 Internet
- 2.6 Let Us Sum Up
- 2.7 Keywords
- 2.8 References and Further Readings
- 2.9 Feedback to Check Your Progress Questions

2.0 INTRODUCTION

Communication, especially advanced communication, is possible through the use of networks and technologies. The history of communication technology is actually the history of human race, as it has always been our efforts to communicate with others, and for that matter use different techniques ranging from the use of sound to fire in the ancient times to telephone and Internet in the modern days. In the context of specific countries, the growth of communication technology has been influenced by their economic and scientific progress. So, we see developed countries using more of communication technology for different purposes (including education) than developing countries.

There are also many technologies that are in operation, and in order to use the best and most suitable technologies for different educational activities that you are expected to perform in distance education, it is necessary that you have a broad understanding of these technologies. In this unit, we will discuss about the technologies of communication, with reference to the networks they use.

2.1 LEARNING OUTCOMES

After working through this unit, you are expected to be able to:

- *Explain* the concept of network;
- *Discuss* the developments of communication technology and networks;
- *Describe* the factors affecting growth of communication networks;
- *Enumerate* the technical operation of different types of networking technologies; and
- *Discuss* the use of communication networks for teaching-learning.

2.2 DEVELOPMENT OF COMMUNICATION TECHNOLOGIES AND NETWORKS

Communication network is a collection of a collection of terminals, links and nodes which connect together to enable telecommunication between users of the terminals. The network may use multiple technologies to transmit the message from one point to the other. The communication between terminals is possible through the use of wire, radio, satellite and wireless technologies. These may manifest through application technologies like radio, television transmission, computer networks, and the Internet.

Communication is a fundamental human and social process. It makes the existence of societies possible, and by its nature, distinguishes between the human and other species (Schramm, 1973). The functioning of any society thus depends upon the quality of communication among its members (Melody, 1986). In other words, the prosperity of a society is judged by the extent to which its members can afford and use various modes of communication — the printed text, radio, television, video cassette recorders, video text, computers, etc. This is the reason why now-a-days more emphasis is being given to the manufacture, storage, processing, editing, interpretation and transmission of information to one and all. With the advancement in and access to a variety of communication technologies we are moving towards an information-based society.

We should know a bit about the history of the growth of communication technologies. So, we shall touch upon the historical development of communication technology and networks in this section. You may be aware that the growth of communication techniques has a long history. For centuries, people developed their own ways to expand their ability to communicate as effectively and efficiently as possible under their respective circumstances. Use of signals, symbols, gestures, facial expressions, etc. were the primitive ways of communication prevalent in primitive societies. It took centuries for the first mass medium — print, to be developed and used for communication purposes.

In this sub-section we shall discuss communication technologies other than the print media.

The earliest form of machine based transmission of message was the use of telegraphy. The word telegraphy has been derived from two Greek words: *tele* meaning far and *graphein* meaning write. The device that is used for telegraphy is called a telegraph. The use of telegraph has been there since 1800s. However with the development of the Morse Code in 1938 by Alfred Vail, assistant of Samuel F.B. Morse, the use of telegraph became an important means of communication for the masses. The Telex Network, established in 1920 revolutionized business communications across the globe.

The invention of telephone in 1876 by Alexander Graham Bell has probably transformed the way people communicate. In order to communicate from one end to the other the telephone use a Public Switched Telephone Network (PSTN) that must be wired from end to end. This is called the fixed line network. The technical operation of PSTN uses the interconnection standards created by International Telecommunication Union (ITU) for allocation of codes to different countries, locations and numbers thereby making possible for telephones to communicate seamlessly.

Another development in the 19th century was the invention of radio. While there is considerable dispute over who invented radio, we may assume that works of many scientists resulted in the use of radio that was initially called *wireless telegraphy*. While Nicola Tesla is considered the inventor of radio in the United States, Guglielmo Marconi is considered the inventor in Europe. The emergence of radio paved the way for audio broadcasting (which popularly later on called radio), and the first commercial public radio broadcasting station came up in 1920 in the United States. The radio stations use either Amplitude Modulation (AM) or Frequency Modulation (FM) as mode of broadcasting radio waves. The AM broadcast are shortwave services and use frequency range of 530-1700 kHz, while the FM broadcasts are in the range of 88-108 MHz.

In the late 19th century and early 20th century, the television made a significant change in the communication, as along with audio it became possible to transmit visuals. Now-a-days television contents are distributed by television channels/ networks through cable operators, satellite and terrestrial transmission.

Timeline for early communication network developments:

Year	Landmarks
1837	Electrical telegraph invented by Samuel F.B. Morse
1838	Morse Code developed by Alfred Vail
1896	Marconi awarded patent for radio
1920	First commercial radio station started in the United States
1923	Vladimir Zworykin patented Cathode Ray Tube based instrument to transmit images
1933	FM radio was patented by Edwin H. Armstrong
1941	First binary electro-mechanical computing device Zuse Z3 developed
1946	Electronic Numerical Integrator And Computer (ENIAC) was developed at University of Pennsylvania by John Mauchly and J. Presper Eckert
1957	Artificial satellite Sputnik 1 launched by Soviet Union
1969	Internet developed as part of Advanced Research Projects Agency Network, USA
1991	Tim Berners-Lee developed the World Wide Web

We will discuss about the specific technologies in this course at various units in detail.

Check Your Progress 2.1

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

b) Compare your answers with those given at the end of this Unit.

Fill in the Blanks.

- i) Telegraphy has been derived from two Greek words: and
- ii) Telephone was invented in the Year
- iii) is considered the inventor of radio in the United States.
- iv) The World Wide Web was developed by
- v) The Internet was developed in the Year

2.3 GROWTH OF COMMUNICATION TECHNOLOGY

The growth, transfer and adoption of technology is not as simple as it may appear, on account of the fact that we are equipped with sophisticated technologies. There are various underlying conditions that influence the way a particular kind of technology is adopted to solve educational problems. Both the developed and the developing countries have almost similar conditions to fulfill for the development of technologies. For instance, the economic strength and enthusiasm of society, the attitude of policy makers, etc. influence the adoption of new technology in both situations the same way (Thomas, 1987). We shall discuss the more significant of these factors in the following sub-section. They are:

- political,
- economic,
- cultural,
- technological, and
- educational.

2.3.1 Political Factors

Communication in the developing countries is not only a socio-economic need but a political necessity too. A political system, i.e., a group of people that holds power can effect the adoption and growth of a particular communication technology in a country. In other words, the introduction of new technology in the service of social change and education depends on the underlying motivation or the will of the political system of the country concerned. You may recall that the rapid growth of computer technology in India, both through import and indigenous industrialization was the result of the interest of the late Prime Minister of India, Rajiv Gandhi. It is an example of the force of political decisions behind the adoption of technology in India, consequent upon which the computer industry flourished in the country manifold. Today, India is one of the major exporters of software in the world.

It is true that technology influences society, but it is also true that society influences the adoption and growth of technology. We, therefore, need to ensure that, rather than getting carried away by the fashion of the day, the communication needs should be identified and evaluated from the country's point of view and then the communication policy for education and development should be formulated/framed accordingly.

Some societies may adopt technology more easily than other because their cultural and linguistic structures may be more adaptable to information processing. You might be aware that Japan took to technology more easily than other countries in Asia. Within a country, the upper classes and capitalists adopt technology more easily and faster than the middle and lower classes; the urbanites go for technology more quickly than the rural people. However the emergence of the mobile phone has changed this scenario, and can become the game changer in communication revolution. There is also social bias that influences adoption of the technology at an individual's level. For example, the young take to technology faster than the old do. The males take to it more easily than the females (HawkrIDGE, 1983). It is reported that girls do not use microcomputers to the extent the boys do in schools, and avoid joining the 'computer club' because it is male dominated. Though there is no systematic evidence for the causes of this

bias, some educators blame the long standing prejudice against mathematics among the girls and mathematics is associated closely with computers. However, this notion is also changing very fast, as use of computers become predominant in the society. Use of computer does not require knowledge of mathematics at higher level, and thus the fear of computers also gets reduced.

2.3.2 Economic Factors

Cost is an important factor that influences the adoption and growth of communication technologies and networks in a country. And this is absolutely true in the case of the developing countries which import technology from the developed countries. They lack sufficient budgetary provision to run or afford technology-based projects. Some countries have made heavy investments in acquiring various technologies without building the necessary infrastructure to make those technologies productive. The point we want to highlight is that investment on new technologies should be seen in terms of the economic growth of the country. We should assess the rupee value of communication technology benefits like the benefits of spending the same amount of money on other measures/areas of social development.

In this subsection, we draw heavily on the discussion presented by Thomas (1987) who focuses our attention on four major economic considerations that affect the use of communication technology in a country. These considerations are as follows:

- financial strength of the society
- attitude of the policy makers
- budget allocation for technology
- cost efficiency of technology.

Let us elaborate on each issue, in the given order.

There are countries which are economically better off with higher per capita income. The per capita income of the developed countries is much higher than that of the developing countries. Since technologies cost huge amounts, it is quite obvious that the country with the higher per capita income is in a better position to afford more communication technologies, and most developing countries lack adequate technologies for communication. They still depend on their traditional methods of communicating. By saying this, we do not mean to suggest that the traditional methods are irrelevant. We, however, believe that those methods have certain limitations, particularly in terms of their reach and efficiency. And if societies want to work on modern social agenda, they must also modernize their communication and technologies.

The adoption and growth of new technology in a country also depends on the attitude of the policy makers towards it. If they perceive communication technology being adopted as a helping hand in the development of the country, they would see that the required technology is adopted and implemented in various areas including the educational systems. The policy makers decide the amount to be allotted or the priority to be given to developing or importing a particular technology for specific purposes. In our country, the policy makers have a favourable attitude towards the utilization of communication technologies, and are quite liberal in recommending and implementing them. At times, they become over-enthusiastic in adopting a technology at various levels of education, even without creating the

adequate infrastructure in the form of required resources, including skilled manpower, maintenance mechanisms, etc.

Then we come to the cost of technology and budgetary provisions to buy or manufacture the tools for technology. Lack of foreign exchange, lack of capital, and the unavoidable difficulties in relation to balance of payments are recognised as principal economic hurdles faced by the developing countries (Jonscher, 1985). The total budget allocated for the education sector is the basis for deciding the amount to be earmarked for the adoption of communication technology. The initial expense to be made on installation of a technology is, as you know, very high. But once a country acquires a communication technology, she can reach and teach an unlimited number of students without involving high budgetary allocation. However, the skilled personnel and receiver equipment require recurring expenses.

The last point to touch upon here is the cost-efficiency of a chosen technology. We have to assess whether by implementing the technology the desired goals have been achieved optimally in terms of money, time and energy spent on it (Thomas, 1987). So the educational planners have to judge the efficiency of the technology being recommended for different target groups. They have to provide convincing answers to several questions, such as, is face-to-face instruction more effective than that done through the radio? Is the television more effective than the radio or vice versa? Such questions are to be resolved before investing in specific communication technologies. The educationists have to ensure that the investment in technology yields greater benefits to a larger number of the students; otherwise it is no good to bring in a technology for use on a large scale.

2.3.3 Cultural Factors

The communication technology plays an important role in disseminating knowledge about cultural heritage and stimulating cultural activities. Culture is a complex whole which includes knowledge, beliefs, art, morals, laws, customs, and any capabilities and habits acquired by a human being as a member of the society (Contractor, Fulk, Monge & Singhal, 1986). There are differences in these cultural factors of various societies all over the world. One society differs from another because of these variations. It is, therefore, assumed that the variations in cultural systems do function as determinants in implementing technologies, their manufacture and utilization. In other words, these variables/variations influence individual as well as group attitude towards various communication technologies.

Thomas (1987) elaborates that the cultural element of language is one of the most important factors in the transfer of the educational software from one country to another. The radio and television programmes, computer software and even printed text are produced in different languages in different countries with different cultural backgrounds. Similarly, philosophical traditions also influence technological exchanges. The adoption of the technologies thus depends on the attitudes, values, beliefs and lifestyles the people in a country have. For example, a confrontation between modernization and traditionalism recently started in India with the infiltration/encroachment of various technologies from the developed societies. For example the use of the World Wide Web without restrictions, and the use of Mobile phones in schools have resulted in controversies, because of use of these technologies for spreading pornography. As a result, a section of the people has become pro-innovation and pro-implementation, while others have stuck to the traditional practices. There was a hue and cry

even in the mid-eighties when the computers were introduced in the banking institutions of India. The bank employees went on strike against automation in the banks. One of their apprehensions was that computers would replace them but it really did not happen. There was another apprehension that the computer would add to the already long queues of unemployed youth in the country. On the other hand the use of computers has opened up more jobs. Again, when for the first time computers were introduced for the management of large examination systems, there were apprehensions expressed by some higher level officers, financial advisers and people in general about the need and desirability of such a step. The actual use of the computers, however, removed their apprehensions. Now-a-days there are no apprehensions about the capabilities of the computers, as it helps us in all walks of life from booking railway tickets at the conveniences of our home to managing my bank account, and even getting online degrees. An important cultural factor in the formal education system is the teachers' resistance and an approach of non-cooperation to any innovation or change in their existing teaching-learning practices. They seem to be quite satisfied with their present methods of teaching and, therefore, see no reason to adopt a new technology and invite unnecessary hardships in terms of money, time and energy. This is an important reason why the modern mass media are not used adequately in spite of their availability in some countries.

Our contention here is not that we should adopt technology without considering the socio-cultural factors. We need to evolve an indigenous model of communication, which has direct relevance to our conditions. The technologies should support our culture and values under the changed conditions. The implementation of communication technologies is greatly facilitated in a homogeneous culture. In other words the successful implementation of communication technologies depends on a match between the values of the two countries: the donor and the borrower. The implementation of technologies is successful, only when it is used to support the activities of the traditional culture, and allows development according to the values and norms of that culture.

For instance, the Satellite Instructional Television Experiment (SITE) project proved successful because the television programmes were shown to the villagers without disturbing their cultural equilibrium. The viewers discussed television messages in a group (teleclub) in the light of the existing practices in the rural society. On the basis of their discussions, they either accepted or rejected the messages broadcast. In this way the utilisation of the television programmes was successful, and it could bring about changes in the viewers' knowledge, skills and attitudes.

2.3.4 Technological Factors

There are various technological considerations that influence the growth and adoption of communication technology in a country. New communication technologies are not free from technical problems. You might have come across instances where you faced a lot of difficulties in handling, using and maintaining new gadgets. For instance, lack of a regular flow of electricity can make technologies defunct. One of the major reasons of under-utilization of the television programmes in the villages in India during the Satellite Instructional Television Experiment (SITE) and the Indian National Satellite (INSAT) project was the irregular supply of electricity. Some problems, particularly relevant to the application of technology for educational purposes are as follows:

Appropriateness: The technology chosen should suit the geographical conditions of the country. Those developing countries which are large, and have a difficult geographic terrain, need technologies that suit them. For these considerations, India's policy of having her own communication satellite to cover the entire country is justifiable. The microwave or cable networking have limited coverage and are too expensive to afford for large scale operations.

Accessibility: We are sure that communication technologies will not be accessible evenly throughout a country for educational purposes. Many households, mostly in poor societies of rural and urban sectors in the developing world, will have none in the near future. The accessibility of modern communication technologies such as the computer, videotext, video disc, videophone, etc., to public will remain extremely limited for many years to come. This does not mean that we are pessimistic about the situation. Far from that, we are of the opinion that the communication technology will be used first for commercial purposes, and not for educational ones in many of our countries. Certain constraints such as lack of sufficient money, lack of interest amongst educators and administrators, lack of sufficient software/courseware, lack of political will, etc. will invariably affect the accessibility of a technology to the educational sectors.

Handling: An electronic device will become redundant if we do not know to operate it. There are devices which, of course, can be operated with simple know-how, but there are some sophisticated devices, which need special efforts and skills to handle them. For example, though a computer is easy to operate, it needs specialized training to use them. More so, because the technologies are changing fast, one finds it difficult to keep oneself up to date in handling and maintaining them. Updating to new operating systems for example is a case in point.

Maintenance: It has been observed quite often that various technologies are imported or adopted from the developed countries without having made adequate arrangements for maintaining them. Once such devices develop technical problems, they become defunct for ever. The reasons for poor maintenance facilities may be due to lack of expertise, lack of resources/infrastructure, non-availability of spare parts, or indifferent attitude of users. For instance, even the most popular/common of devices such as the television set installed in a rural primary schools in many poor countries, are not covered under an effective maintenance scheme.

Software/Courseware: It is a fact that there is a dearth of relevant software/courseware for educational sectors all over the world, including the developed countries. Besides, there is a serious problem of quality software in the developing countries. Most of these countries depend on the courseware imported from the developed countries. Such courseware may not suit the socio-cultural and educational needs of the students of the borrower countries. One of the concerns here is the language of the courseware, which may be difficult for the students to follow. As a result, the actual utilization of such courseware becomes doubtful.

We must admit that designing and producing educational courseware is a complex task, which involves a lot of expertise, equipment and financial support. Designing courseware for the modern communication technologies, such as the computers, online learning, m-learning, etc. is a challenging job. How efficiently the students learn from a lesson depends on how skillfully the courseware has been designed.

Though some developing countries have reached a level of sophistication in producing general radio and television programmes, they do not have a sufficient stock of the educational programmes. The non-availability of the relevant courseware hampers the growth and development of the communication technology in the educational sectors. It is, therefore, necessary to seriously plan and design appropriate software for the new communication technology, (for instance, the talk-back system) otherwise it will take unreasonably long time to get the new technology introduced.

2.3.5 Educational Factors

There are certain educational factors that influence the growth and adoption of the communication technology. These factors are linked with socio-cultural and economic considerations prevailing in a society.

Teachers, the important component of the educational system, play a crucial role in the adoption of a technology, or an innovation. We should remember that teachers can diminish the success of any media at the institutional and actual operational level. They may or may not be willing to make necessary changes in their role, or to deviate from their existing practices as demanded by the technology. Their attitude toward technology is thus an important determinant. Communication technology demands a change in the role of teachers. They should realize that they are no more the only source of information required to transmit knowledge. In other words, new communication technologies will ask the teachers for new roles of teaching managers, facilitators, advisers, counsellor and so on. This is not something new we are talking about. A number of research studies on the educational media have provided empirical evidence to show that these devices demand that the teachers should play new roles.

There is an undercurrent of skepticism among some educators that the adoption of a technology may lead to further elitism in education: widening the gap between those who have access to resources and those who do not have. Adoption of technology needs a lot of resources, and every institution cannot afford to have such costly devices. Moreover, the government cannot make technology available to every student to work with. Thus adopting technology in education will rapidly create a new elite class, if it is introduced selectively.

Attainment of learning objectives is the main function of communication technologies. Besides the other attributes of software/courseware, the language of instruction is a determining factor for its success or failure. Even the same courseware produced by a foreign and a local agency in the same language produces different impacts. In an Indian study, for example, conducted by the University Grants Commission (UGC) Research Advisory Committee for INSAT-IB programmes, it was found that the programmes (in English) imported from other countries contributed little to the comprehension of the subject matter as compared to the programmes (in English) produced in India. The students faced problems in comprehending the language, mainly because of the pronunciation of the foreign experts.

Besides, there are some additional factors that influence decision-makers to ignore or adopt technologies for educational purposes. Some of these are as follows:

- The teachers are usually not involved in planning and preparing the courseware (there is a difference between software and courseware- 'software' refers to computer programming while 'courseware' refers to all teaching materials that store information, e.g., radio and television

programmes) for the students. The perception of the producers may differ from that of the teacher. This is the reason why teachers do not look at these devices with favour.

- There is another problem with the courseware. From the qualitative point of view, the scope of the content of the courseware may be limited, and the presentation of the content may be inadequate. From the quantitative point of view, it is very difficult to cover the entire syllabus by one technology (medium). Therefore, other media are required to achieve the educational objectives in their totality, but it is very difficult for many countries to adopt the multimedia approach to teaching-learning.
- There is a dearth of variety in the courseware in developing countries. The material borrowed from the developed countries may not be suitable for the students of developing countries; the software may not suit the needs of individual students.
- The teachers and the students may feel that the written and spoken communications are still popular in education. The students' dependency on the books and the teachers' lectures discourages them to make use of the modern communication technology. For instance, the Japanese, in spite of being a super industrial society, continue to depend on teachers for teaching-learning purposes. Thus education still suffers from a kind of intellectual imperialism, i.e. the teachers feel that they are the only competent means of teaching the students.
- Some communication technologies are more effective for pedagogic purposes than others. Educationists prefer the technology, which has the potential to solve educational problems and can consequently improve the quality of instruction.

Check Your Progress 2.2

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

b) Compare your answers with those given at the end of this Unit.

- 1) What are the four major economic considerations that influence the use of communication technology?

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- 2) What are the main cultural and technological factors that influence the adoption and growth of communication technology in a country?

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2.4 COMMUNICATION NETWORK TECHNOLOGIES

Broadly, today communication takes place through some kind of network technology. While networks can be developed simply with the use of wire in a small room or in a campus, we are more interested in network technologies that foster networking in a wide area facilitating distance learning. We will discuss some of these technologies in this section.

2.4.1 Communication Satellites

A communication satellite is a spacecraft that receives signals from a transmitter on earth and amplifies these signals, changes the carrier frequencies, and then retransmits the amplified signals back to the receivers on earth. The communication satellites are usually placed in a special earth orbit, which makes them appear stationary to the transmitters and receivers on earth. There are more than a hundred of these communication satellites in orbit around the world, and new satellites are being launched regularly.

The space age started in 1957 with the launching of *Sputnik* by the former USSR. Since then, a number of satellites have been launched for various purposes: telecommunications, meteorology, remote sensing, disaster warning, defense and so on.

The key to satellite-based communication is not simply the satellite itself, but other elements as well $\frac{3}{4}$ a ground based transmission station known as uplink, and a receiving disc known as downlink. The uplink sends signals to the satellite, which amplifies and retransmits them back to the downlink, i.e. the direct receiving disc, which in turn feeds a local station. See Figure 2.1.

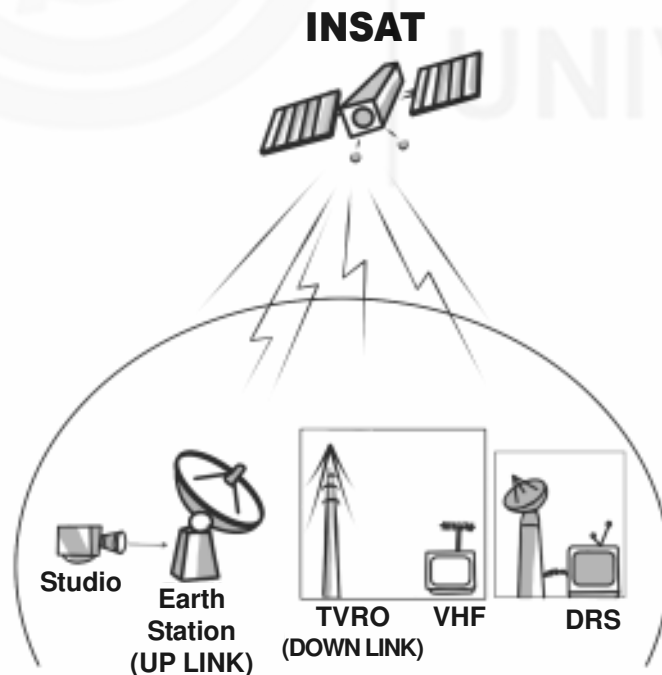


Figure 2.1: Communication Process

Launching of satellites

A satellite is launched into a geostationary orbit using either an unmanned vehicle or a piloted space shuttle that is reusable. The machine, popularly known as the Satellite Launch Vehicle (SLV), has one or more rocket stages that provide the acceleration needed to launch a satellite into the desired earth orbit. The satellite is normally placed in a circular earth orbit by the SLV and then transferred, shifted or fixed into a geostationary orbit. A special rocket in the satellite provides the acceleration needed to transfer the satellite from a circular orbit into a geostationary orbit. This special rocket in the satellite is called an apogee motor or an Apogee Kick Motor (AKM).

The space shuttle provides an alternative method of launching communication satellites. Launching satellites with a space shuttle is less expensive than using unpiloted launch vehicles because a space shuttle can launch more than one satellite on a single mission and then it can be reused (Douglas, 1988). Once the satellite is fixed in the geostationary orbit, it rotates in the same direction as the earth, at a velocity that equals the rate at which the earth rotates.

In a short span of time, communication satellites have become the predominant carriers of long distance communications. Since 6th April 1965, when the first commercial satellite, INTELSAT, was launched, the satellite industry has grown to handle most national and international communications. The satellite is used for direct broadcasting in many countries.

In India, the first Indian National Committee on Space Research (INCOSPAR) was founded in 1982 for conducting space science experiments. The primary objectives of the Indian space programme are to develop indigenous capability in advanced space technology/engineering; to develop capability for various applications of space technology for national development; and to build scientific manpower for space science and technology. The late Vikram Sarabhai, the first head of the Indian Space Research Organization, opined that India, with its vast size and population, and low level of economic development and literacy, should draw the benefits of satellite technology to create a nation-wide television service for instructional, educational, and related developmental purposes (Srirangan, 1985). It took 15 years for Sarabhai's dream to be fulfilled in the shape of the INSAT-A multi-purpose system. The INSAT series has made tremendous progress, and today India has a dedicated satellite for Education, Science and Technology (EDUSAT). More about satellite in education are discussed in Unit-8.

2.4.2 Computer Networks

Have you ever been amazed at the thought that you can dial a remote telephone number in your own locality, country or abroad and instantly get a reply? Perhaps not! The fact is that we have grown up with such technology and have been using it for such long periods that we have taken it for granted. Telephones are connected either by wires or through a satellite, which expedites connection between two telephones.

Unlike telephones, the computer was developed as a 'stand alone' device to be used in certain situations by an individual or group in isolation. Once the machine was developed it was felt that connecting different computers either in close proximity or placed at a distance from each other could provide access to powerful computing capability and information which

would be very helpful in making computer communication possible. This facility can and has been of great help in completing tasks requiring group efforts. Different people can keep working on their own terminals and compile the work on a common computer remotely placed. The facility of working from different sites provides the opportunity to work at flexible and convenient hours.

The linking of two or more computers, terminals and peripheral devices is termed a *network of computers*. Computers are networked for on-line data-communication and sharing of resources such as common printers, hard-drive space, modems, CD-ROM drives; exchanging files and sharing databases. The resources shared in a network may be physical devices or information kept in databases. Online data communication supported by a network facilitates not only a highly interactive mode of communication but also the quicker transmission of information. Distributed databases and distributed data processing are also very important features of networking. A network reduces the cost of maintaining databases and specialized software.

Advantages of Computer Networking

Some major advantages of computer networking could be as follows:

- **Resource sharing:** All computer users do not have the best computer facilities available on a stand-alone computer. Acquiring a main-frame computer can never be a cost feasible option for an individual or a small organization. Similarly, expensive peripherals like sophisticated printers, large hard disks etc. can not be attached to individual computers for the same reason – that of high costs. But if we can interconnect (network) the small computers and terminals with a powerful processor, secondary storage, printers, etc., then all these small computers can utilize the powerful resources interconnected through a network.
- **Global database:** When different computers are interlinked and can share resources then there is no need to store the same or similar information on the storage areas of individual computers. Data that needs to be shared by different users can be stored and maintained at a global storage area and users can be given access to it with their user-ids (user identification code kept for unique recognition of the user by the computer) and passwords (used for protecting a user's data from other users). For example, if some study material or reference material is prepared for many students, it can be stored in one computer storage area and made available through a network to all those who need it.
- **Powerful communication medium:** We are all aware of the rate of growth of information and the use of up- to- date information, primarily in education and research, and also in other areas of life. Traditional means and media of information creation and dissemination like print, recorded audio and video devices are cumbersome and very slow. The information stored and disseminated through networks has recently become the most popular means because of the simple editing process and the facility of fetching data from all the different sites in the world. Some other means of communication may be equally fast but they are both very expensive and incapable of carrying big databases. In the DE the students can log on to the databases of the universities and benefit from them in various ways, e.g. be informed about the latest in research, navigate through one information topic to another, have an online explanation of different topics.

- **Information management:** Management of information in a global database is also easier in a networked setup. Any database in such a setup will not have a duplicate copy and so editing, updation, deletion, etc. are all required to be done at one place. This is in contrast to the systems of maintaining local databases where information may have duplicate entries in different individual databases, and in order to change any component of the information, all the databases keeping that component must be changed accordingly. Failing to do so will give rise to ambiguous and hence incorrect information. In a network, data is also protected from any unauthorized use.
- **Online information exchange:** It is already stated above that a network facilitates an online information exchange. Now we have to understand the advantages of this on-line exchange of information. Any information is kept for people to use in any way they want to use and when ever they want. Using a computer attached to a network, one can easily and quickly access information in the right format, which can be used for further work and timely decision making.
- **Saving money:** All the above stated properties — resource sharing, global information maintenance, rapid information exchange – of a network system reduce the cost of information storage and interchange. Although the initial setup cost of a network may appear high, the overall running and other future costs in totality save money. Also, a bigger network system may be planned but it can be built in phases starting with a smaller setup, such as adding an extra, which node, which is not at all a problem, if planned in advance. This will reduce the initial setup cost, if arranging for finance is a problem.

Data Communication Channels

In a network all the computers and other devices are joined through data communication channels. These channels are of two types – one which uses some physical medium for the transmission of data e.g. a pair of twisted copper wires (like telephone lines), coaxial cables (like television cables) and optical fiber cables; and the other one which uses the property of microwaves and communication satellite systems.

- A pair of **twisted wires** is the most common medium. Two copper wires are twisted together to reduce electrical interference from similar pairs lying close by. The twisted pair can transmit both analog and digital signals. It is the cheapest transmission medium in use.
- **Coaxial cables** comprise a stiff copper core surrounded by an insulated cover, which is in turn encased by a woven mesh of conductor. The whole structure is covered with some plastic material. It has a higher speed of transmission and better shielding.
- **Optical fibres** are very high transmission channels. They are most expensive of all the physical mediums and the detectors. When there is a pulse of light it is sensed as **1** and the absence of light is taken for **0**. Refraction of light occurs whenever there is a change in the density of the medium in which light beams are passing. By total internal reflection light is trapped inside the fiber and travels a long distance at the speed of light.

Network Topology

There are two types of technology for the transmission of network, point-to-point and broadcasting. In a **point-to-point** network, the connection is between individual computers whereas in the **broadcasting** type of transmission there is a single channel used for transmission of data in packets. All the data packets sent by any machine are received by all the

other computers and the address part of the packet is checked by the receiving computers. If it is meant for them it is used and otherwise simply ignored.

The structure of the linking of computers using data communication channels is known as a **topology of network**. It can be of many different styles but a few standard structures are used in computer networks. Let us discuss the four topologies of networks.

Star Topology

There is a central computer (called the host) in the star network, which is linked with all the other computers (called nodes) in the network and all the nodes are connected to each other through the central computer alone.

Adding and deleting a node in this network is much simpler as connection is setup/deleted only between the host and the node. The initial setup cost of such network is also low. The biggest disadvantage of this topology is that the network fails if the host breaks down (Figure 2.2).

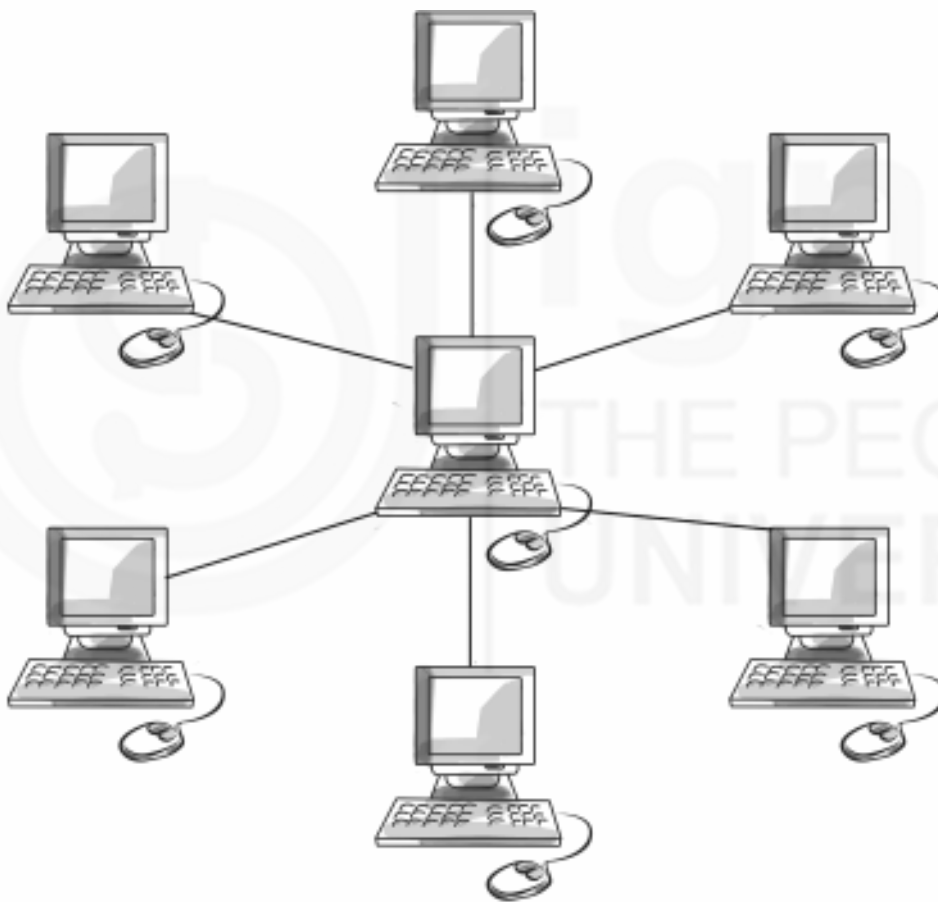


Figure 2.2: Star topology

Ring Topology

In the ring topology all the computers in the network are connected to two other computers. The shape of the network is like a ring, as shown in the diagram below. The data transmission in the ring topology is bi-directional for any individual machine. So, even if a connection fails for a particular machine it has another side for connecting to others, although the ring structure breaks. The initial setup cost is low and adding/deleting nodes is easier (Figure 2.3).

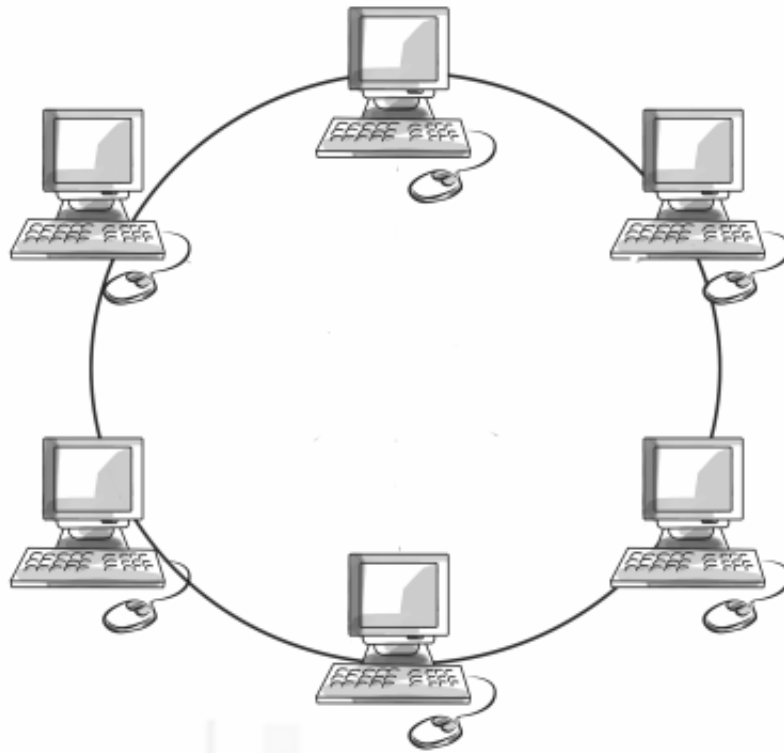


Figure 2.3: Ring topology

Bus Topology

It is also known as the linear connection network. It is the broadcasting type of transmission used in Local Area Network (explained in the next section). Only one machine is allowed to send data at a time. If two machines try to send data at the same time both have to wait individually for different random times (Figure 2.4).

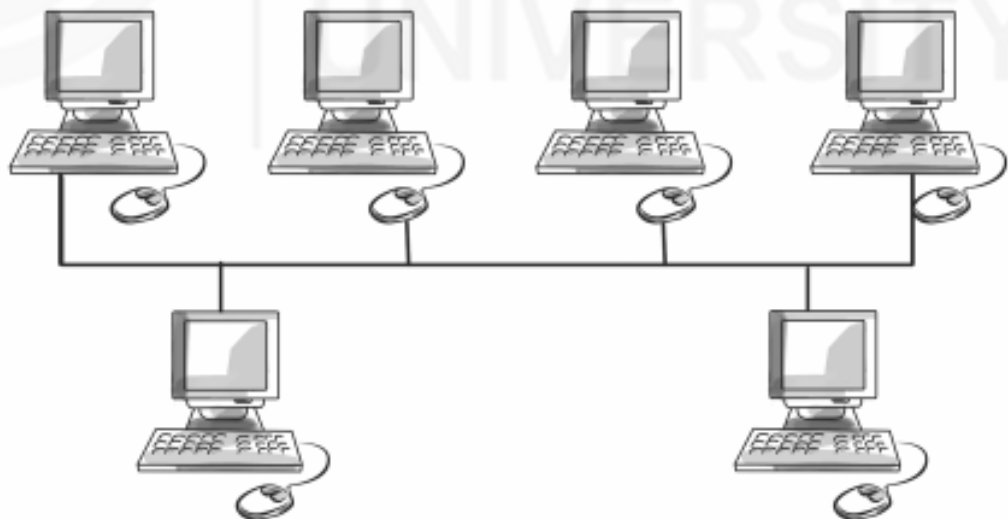


Figure 2.4: Bus topology

Fully-connected or Mesh Topology

In this type of technology each computer is connected to all the other computers. Adding/deleting a node in such a network is costly. The initial setup cost is also very high. But the communication in it has high reliability, as each computer has many links (Figure 2.5).

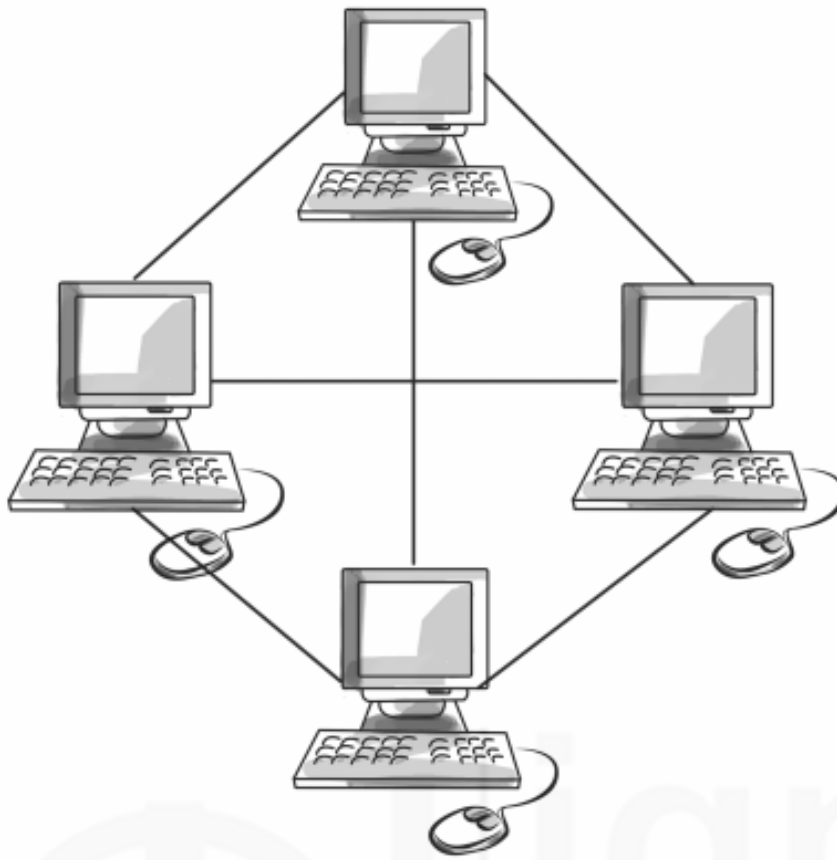


Figure 2.5: Mesh topology

Network Types

Networks can connect two computers on the same desk or connect computers around the world. Based on the usages and geographical coverage area of the network, a network can be classified as:

- Local Area Network (LAN)
- Metropolitan Area Network (MAN)
- Wide Area Network (WAN)

Local Area Network connects computers and electronics devices within a limited geographical area e.g. a building of some functional unit of an organization, R & D unit, etc. Normally, a LAN functions within a range of 10 kms area. It may have different types of computers, mostly microcomputers (PCs), and peripheral devices attached with a variety of data communication wires or cables.

Different departments or sections of an organization may like to share information to expedite their jobs. For example, in a university set-up, the examination department may like to have information about the total number of students admitted to a particular course, to arrange for the examination. Similarly information about finance, degree distribution etc. may be sought. It will be of great help if all the information is available at one place without requiring the person to go from one department to the other.

The facility of LAN has become so popular that since 1987 all Macintosh and now all computers produced by different companies, are produced with the built in capacity for networking. The networking software has now become part of the operating system. Vishwanathan (1992) lists the following six advantages offered by LAN:

- 1) Unlike a large centralized system, a LAN may evolve with time. It may be put into operation with a small investment, and more systems may be added as the need arises.
- 2) Since LAN is a set of multiple interconnected systems, it offers a good back up capability in the event of one or two system failing in the network. This, in turn, enhances the reliability and availability of the systems to users.
- 3) LAN provides a resource- sharing environment. Expensive peripherals, hosts and databases may be shared by all the LAN users.
- 4) A LAN adhering to a certain standard permits multi-vender systems to be connected to it. Thus, a user is not committed to a single vendor.
- 5) In LAN, the systems are generally so chosen as to meet most of the user requirements locally and the network is used only for resource and information sharing purposes. Due to this, each user gets a better response than would be the case in a centralised system. LAN tends to exhibit an improved performance.
- 6) LAN offers flexibility in locating the equipment. Most computers on a LAN are physically placed at the user table, which is most convenient for working and improves the productivity significantly.

Metropolitan Area Network usually covers a geographical area spanning a distance of 5-50 kms. Network topologies used in MAN are similar to LANs: Star, Bus, Ring. As such MANs are extensions of LANs. The transmission media most suitable for MANs applications are broadband coaxial cable and optical fibres.

Wide Area Network is a large area network, which covers different cities or countries. A WAN uses a point-to-point transmission technology. Local area networks may be connected to wide area networks by a common processor called the *gateway*, which is used as a common interface. As mentioned above, there is no satisfactory definition to explain a WAN but it seems to have one definite quality and that is it must make use of a telephone line. WANs tend to become quite complicated and so they are losing their popularity to Intranet and Internet.

Check Your Progress 2.3

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

b) Check and compare your answers with those given at the end of this unit.

- 1) What are the advantages of computer networks?

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2) Which of the following statements are True (T) and which False (F)?

- a) The twisted pair cable can transmit both digital and analog signal ☐
- b) In ring topology, the breakdown of a system causes failure of the network ☐
- c) The geographical coverage of a MAN is usually within 5-50 kms. ☐
- d) Interconnection of networks and devices is done through standards and protocols. ☐

2.4.3 Wireless Networks

Wireless network refers to a type of communication network that transfers information over a distance without the use of wire. Wireless communication networks are implemented using radio, infrared, and microwave as the carrier. So, they have applications in home appliances, radio broadcasting, mobile telephony, etc.

The radio based network system contains a transmitter that consists of a source of electrical energy, producing alternating current of a desired frequency. The transmitter also has a system to change some properties of the energy produced to impress a signal on it. This change might be as simple as turning the energy on and off, or altering more subtle properties such as amplitude, frequency, phase, or combinations of these properties. The transmitter sends the modulated electrical energy to a tuned antenna; this structure converts the rapidly-changing alternating current into an electromagnetic wave that can move through free space. The electromagnetic wave is intercepted by a tuned receiving antenna and re-converted to electrical currents. At the receiver, these currents are demodulated and the information is received in the form sent.

Microwave based wireless networks use electromagnetic waves with wavelengths ranging from as long as one meter to as short as one millimeter, or equivalently, with frequencies between 300 MHz (0.3 GHz) and 300 GHz. The frequency of microwave is shorter than the radio. Infrared based wireless networks use electromagnetic radiation with a wavelength between 0.7 and 300 micrometres, which equates to a frequency range between 1 and 430 terahertz. Thus, it is used for short range communication within home and offices.

Wireless networks are of different types:

- Personal networks through Bluetooth (uses a radio technology called frequency-hopping spread spectrum and transmits up to 79 bands of 1 MHz width in the range 2402-2480 MHz). It normally has a maximum range of about 100 meters.
- Wireless LAN through Wi-Fi (short for *Wireless Fidelity*; a trademark of Wi-Fi Alliance that is based on IEEE 802.11 technology). It is used for personal computers, laptops, printers, personal digital assistants, smartphones, etc. Wi-Fi networks have limited range (say about 95 meters), but can be enhanced by use of access points. It uses radio frequency at 2.4 GHz.

- Wireless MAN though WiMAX (short for Worldwide Interoperability for Microwave Access, and is based on IEEE 802.16 standards that is considered the broadband wireless standard). It provides mobile broadband connectivity in a city, as it can have a range of 50 KM. However, the speed decreases as the distance becomes more.
- Wireless WAN is achieved through Global System for Mobile Communication (GSM). The second generation (2G) GSM operates in the 900 MHz or 1800 MHz bands, and has General Packet Radio Service (GPRS) for data transfer. GPRS enabled phones allow access to the Internet, although at a low speed. However the 3G based mobile applications can have mobile TV, video on demand service, video conferencing etc. as 3G systems can in practice offer up to 14.0 Mbit/s on the downlink and 5.8 Mbit/s on the uplink.

2.5 INTERNET

Internet is an open non-participatory computer communication infrastructure that reaches every corner of the globe, carries information on every topic and is available to users round the clock. Technically it is a global collection of interconnected networks. It allows computer users to share equipments, programmes and information available in different sites. It is sometimes referred as the ultimate “information superhighway”.

The history of the Internet began at the peak of the cold war in the 1960s. The Defense Advanced Research Project Agency (DARPA) of the USA was funded to find ways for scientists and laboratories to share expensive computer resources. The outcome of the research manifested in the form of the Advanced Research Project Agency Network (ARPANET) which went online in 1969. People at the Rand Corporation, The Research and Development unit of the American Army, were quite worried about the probability of a communication breakdown in the event of a nuclear attack. The communication networks at that time were based on point-to-point connections, which were linked in chains. Functioning of these types of networks relies largely on the links between each pair of points in the communication system, and a breakdown at any point in the network would subsequently halt any communication through networks.

To tackle the problems associated with the point-to-point network, an idea for a new kind of connection in the network was conceived by the Rand thinkers. The new type of network was more like a spider net which connected different points through different channels. In the event of a breakdown in one of the sections, the communication could be carried on through other routes. The first real Internet connection was established between four US universities namely Stanford Research Institute, UCLA, UC Santa Barbara and the University of Utah.

Growth of the Internet

In 1973 the ARPANET provided, for the first time, international connection to agencies outside US, viz. University College in London, England and the Royal Radar Establishment in Norway. As maintained earlier, the Internet is an international network of networks where different types of computers are connected for purposes of communication. Unlike the earlier LANs where the platform of network was homogenous we have now computers running on heterogeneous platforms for communication. All the machines in the Internet are glued together with the Transmission Control Protocol/Internet

Protocol (TCP/IP) reference model and TCP/IP protocol stack. A machine can be connected to the Internet, if it can run the TCP/IP protocol; has an IP address and has the ability to send IP packets to other machines on the net.

The Internet has grown very fast over the years. From only 4 hosts in 1969 in the ARPANET, it had grown to include 37 computers in 1972. Later the name changed to ARPANET. By 1983 it had more than 500 hosts and thus the military research component was moved to another network called MILNET. At the end of 2009, every 4th user person in the World had access to the Internet. You can search the World Wide Web (particularly the ITU site) to know the latest growth in terms of number for specific countries and region. Another site for this purpose is <http://www.internetworldstats.com/stats.htm>

How Internet works?

The Internet works on the Transmission Control Protocol (TCP) and Internet Protocol (IP). These two are collectively called TCP/IP. For sending data into another machine TCP divides the data into little packets and IP puts the destination address on each packets. The Internet addresses have two forms — one for the understanding of the user and the other for the machine. Typically, an address on the Internet looks like this:

<http://www.host.subdomain.domain>

Where http is the hypertext transfer protocol, www stands for World Wide Web, *host* is the local network server (such as ignou) grouped into domains. The *domains* are classified as geographic and non-geographic. Table-2.1 shows the list of domain names. The user of the internet types the address in a browser, which using the network of the Internet Service provider (ISP), search for the address to locate it. When the server is located, it serves/ returns the page (normally the home page) asked for to the computer that initiated the request.

Table 2.1: Domain names in Internet

Geographical		Non- Geographical	
.in	India	.com	Commercial organization
.au	Australia	.net	Networks
.de	Germany	gov	Government
.jp	Japan	.mil	Military networks
.uk	United Kingdom	.edu	Educational institute
.ca	Canada	.org	Organization

Who governs it?

By now, you must be thinking ‘Who owns the Internet?’ or Who governs the Internet? The answer to this million dollar question is: no one. The beauty of the Internet is that it has grown up and evolved as an open system where individuals and organizations can join and become online. In terms of technology of the Internet there are several bodies that look after the technical standards. The following organization oversees the development of the Internet.

- **Internet Society.** Established in January 1992 as the authority for the development of the Internet, it comprises individual and organizational members charged with maintaining the long-terms viability of the Internet.

- **Internet Architecture Board.** It joined the Internet Society in June 1992 to oversee the architecture and protocols used by the Internet.
- **Internet Engineering Task Force.** Started in 1986, the TETF oversees the complex and detailed work of developing and standardizing the Internet Protocol suite.
- **Internet Engineering Steering Group.** It provides management of the Internet standard process.
- **World Wide Web Consortium:** Founded in 1994 to develop common standards for the evolution of the web.

In 2005, the World Summit on Information Society held at Tunis established the Internet Governance Forum to discuss Internet related issues. The Internet Corporation for Assigned Names and Numbers (ICANN), headquartered in Marina del Rey, California administer the domain name and registration of hosts. ICANN is governed by an international board of directors drawn from across the Internet technical, business, academic, and other non-commercial communities.

You will study more about Internet and its application in various units of this course.

Check Your Progress 2.4

Notes: a) Write your answers in the space given below

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

- 1) Identify the different parts of the following Internet address.

http://www.ignou.ac.in

http://www.egyankosh.ac.in

.....

.....

.....

.....

.....

- 2) Write 'T' for True and 'F' for False statement.

a) Infrared based wireless networks use electromagnetic radiation with a wavelength between 0.7 and 100 micrometres ☐

b) Bluetooth (uses a radio technology called frequency-hopping spread spectrum) ☐

c) No one governs the Internet. ☐

2.6 LET US SUM UP

In this unit we discussed the technology behind the communication processes. We started by discussing the historical developments of communication technologies and networks for the days of the telegraph to the Internet and its World Wide Web. We discussed the economic, technological, political, educational and sociological factors affecting the use and growth of communication technology in a country. You also discussed the developments in the satellite technology to promote communication networks, and the computers and communication networks. We also

identified and discussed the technologies behind wireless communication networks.

Towards the end of this unit, we discussed Internet as the network of networks to provide end to end communication that may use computer networks, wireless networks and satellite networks or a combination of these. While you are not supposed to know the technological details of these networks, it is important to have some understanding of the technologies and its operation to take appropriate decisions on the use of communication technology for teaching and learning.

2.7 KEYWORDS

Communication network: is a collection of a collection of terminals, links and nodes which connect together to enable telecommunication between users of the terminals.

Internet: is an international network of networks where different types of computers are connected for purposes of communication. The Internet works on the Transmission Control Protocol (TCP) and Internet Protocol (IP).

Local Area Network: connects computers and electronics devices within a limited geographical area.

Metropolitan Area Network: usually covers a geographical area spanning a distance of 5-50 kms.

Satellite: is a spacecraft that receives signals from a transmitter on earth and amplifies these signals, changes the carrier frequencies, and then retransmits the amplified signals back to the receivers on earth.

Wide Area Network: is a large area network, which covers different cities or countries.

Wireless network: refers to a type of communication network that transfers information over a distance without the use of wire.

2.8 REFERENCES AND FURTHER READINGS

- Contractor, N.S., Fulk, J., Monge, P.R., & Singhal, A. (1986). Cultural Assumptions that influence the Implementation of Communication Technologies; *The paper presented at the conference organised by the International Association. for Mass Communication Research*, New Delhi, August 25-29, 1986.
- Hawkrige, D. (1983). *New Information Technology in Education*, Croom Helm, London
- Jonscher, Charles (1985). Assessing the benefits of telecommunications, *Intermedia*, Vol. 13(1).
- Schramm, W. (1973). *Men, Message and Media-A Look at Human Communication*, Harper & Row Publishers, New York
- Srirangan, T.V. (1985). 'Why Orbit Planning: A View from a Third world Country Part I: Indian Communications', in *New Directions in Satellite Communications*; Hudson, Heather, E, Artech House.
- Vishwanathan, T. (1992). *Telecommunication switching systems and networks*, Prentice Hall, New Delhi.

2.9 FEEDBACK TO CHECK YOUR PROGRESS QUESTIONS

Check Your Progress 2.1

- i) tele and graphien
- ii) 1876

- iii) Nicola Telsa
- iv) Tim Berners-Lee
- v) 1969

Check Your Progress 2.2

- 1) The four major economic considerations are
 - financial strength of the society
 - attitude of the policy makers towards communication technology
 - budget allocation for communication technology
 - cost efficiency of the technology
- 2) The main cultural factors are — language, beliefs, arts, values morals, customs, laws, attitudes, habits, etc.

Check Your Progress 2.3

- 1) The advantages of computer networks are :
 - Resource sharing
 - Access to global databases
 - Powerful communication
 - Improved information management
 - Interactive information exchange
 - Time and money saving.
- 2) (a) True (b) False (c) True (d) True.

Check Your Progress 2.4

- 1) In <http://www.ignou.ac.in>, ignou is the host server, ac is for academic domain (here it is sub-domain) and in for India (as geographical domain).
In <http://www.egyankosh.ac.in>, egyankosh is the host server, and the rest as for above.
- 2) a) False b) True c) True

UNIT 3 PEDAGOGICAL DESIGNS FOR COMMUNICATION TECHNOLOGY

Structure

- 3.0 Introduction
- 3.1 Learning Outcomes
- 3.2 Design and Pedagogy
 - 3.2.1 Pedagogical Design as a Creative Process
- 3.3 Pedagogical Design: Process
- 3.4 Some Typical Pedagogical Designs
 - 3.4.1 Anchored Video Instruction
 - 3.4.2 Collaborative Learning
 - 3.4.3 Problem-based Learning
 - 3.4.4 Discovery Learning
 - 3.4.5 Scenario-based Learning
 - 3.4.6 Case-based Learning
 - 3.4.7 Learning by Designing
 - 3.4.8 Self Learning
- 3.5 Let Us Sum Up
- 3.6 Keywords
- 3.7 References and Further Readings
- 3.8 Feedback to Check Your Progress Questions

3.0 INTRODUCTION

The use of communication technologies in teaching and learning process require us to think, plan and design its appropriate use to result in optimum level of effectiveness. We can't use technology indiscriminately for educational purpose. Just because technologies are available, they should not be used for teaching and learning without thinking about their appropriate usefulness. While access and availability are important considerations, the context of use (such as classroom, distance learning, online learning) becomes more significant for deciding on the *right* communication technology. However, there is no wrong technology as well. The appropriate mix and match of technology and pedagogy makes a technology better than another.

Education is all about student learning, and educators use technology to improve teaching and student learning. All technologies cannot be used in all the situations. With the change in learner profile and the context, the effectiveness of a technology would change, and therefore, it is the task of the teacher to think about the use of technology in specific contexts. You have studies about the instructional design models and learning theories in MDE-412, and in this unit, we would discuss some of the pedagogical designs for use in technology-mediated teaching and learning environments. As a distance educator, you should be aware of the different instructional design processes which are tailored to different contexts of teaching and learning.

3.1 LEARNING OUTCOMES

After working through this unit, you are expected to be able to:

- Define design and pedagogy;
- Describe pedagogical design as a creative process;
- List various pedagogical designs available for teaching through communication technology; and
- Discuss advantages and disadvantages of various pedagogical designs in an ICT-enabled environment.

3.2 DESIGN AND PEDAGOGY

The *Oxford Advanced Learner's Dictionary* equates 'design' with 'arrangement', 'drawing', 'plan', 'model', 'pattern' and 'intention' with the meaning 'the art or process of deciding how something will look, work etc., by drawing plans, making models etc. *Design is that area of human experience, skill and knowledge which is concerned with human being's ability to mould his or her environment to suit his or her needs.* Design is essentially a rational, logical, sequential process intended to solve problems. The process begins with the identification and analysis of a problem or need and proceeds through a structured sequence in which information is researched and ideas explored and evaluated until the optimum solution to the problem or need is devised. Design may also refer to the process of devising a system, component, or process to meet desired needs in any given field of human experience.

Design refers to a plan/document/blueprint for making something work. As a verb, "to design" means the process of developing a plan for a product, system, structure, etc. Used as a noun, "a design" may refer to a proposal, a model, a blueprint, etc. The person who creates a design is called a designer (such as instructional designer).

As you might have known, the word 'pedagogy' comes from the Greek word 'paidagôgeô' (*paid*: child and *ágô*: lead) literally meaning "to lead the child". The Encyclopedia Britannica refers to pedagogy as study of teaching methods, including the aims of education and the ways in which such goals may be achieved. The word pedagogy in the modern context refers both to the art of teaching and science of learning.

When you think of design in the context of pedagogy, taking into consideration the foregoing discussion design and pedagogy will lead to a working definition on pedagogical design. You might have also heard of the term 'instructional design' in the field of education. What is Instructional Design? Instructional Design is the systematic process of translating general principles of learning and instruction into plans for instructional materials and learning. Instructional Design can be perceived in different ways as given below:

Instructional Design as a Process

Instructional Design is the systematic development of instructional specifications using learning and instructional theory to ensure the quality of instruction. It is the entire process of analysis of learning needs and goals and the development of a delivery system to meet those needs. It includes development of instructional materials and activities; and tryout and evaluation of all instruction and learner activities.

Instructional Design as a Discipline

Instructional Design is that branch of knowledge concerned with research and theory about instructional strategies and the process for developing and implementing those strategies.

Instructional Design as a Science

Instructional Design is the science of creating detailed specifications for the development, implementation, evaluation, and maintenance of situations that facilitate the learning of both large and small units of subject matter at all levels of complexity.

Instructional Design as Reality

Instructional Design can start at any point in the design process. Often a glimmer of an idea is developed to give the core of an instruction situation. By the time the entire process is done the designer looks back and he or she checks to see that all parts of the “science” have been taken into account. Then the entire process is written up as if it occurred in a systematic fashion.

Gagne and Briggs (1974) give four basic assumptions of instructional design which deserve a closer study. The first assumption is that instructional planning must be for the individual i.e. the instruction is to be oriented towards the human individual in his or her development from child to adult, as well as throughout the life. The second assumption is that the instructional design has phases that are both immediate and long-range. Here, design in the immediate sense is what the teacher does in preparing a “lesson plan” some hours before the instruction is given. The long-range aspects of instructional design are more complex and varied. They are more likely to be concerned with a set of lessons organized into ‘topics’, a set of topics to constitute a course or course sequence, or perhaps with an entire instructional system. The third assumption is that systematically designed instruction can greatly affect individual human development. Because, unplanned and undirected learning is almost certain to lead to the development of individuals who are in one way or another incompetent to derive personal satisfaction from living in our society of today or tomorrow. The fourth assumption is that designing instruction must be based upon knowledge of how human beings learn. Also, instructional design must take into account fully the learning conditions that need to be established in order for the desired effects to occur.

Besides these assumptions, a synthesis of the literature on Instructional Design reveals that pedagogically solid designs involve authentic, hands-on tasks; use familiar and easy-to-work materials; possess clearly defined outcomes that allow for multiple solutions; promote student-centered, collaborative work and higher order thinking; allow for multiple design iterations to improve the product. You have studied instructional design in detail in MDE-412.

3.2.1 Pedagogical Design as a Creative Process

Like any design process, pedagogical design can also be considered as a creative process. It is said that design is the process of ‘management of constraints’. These constraints can be of two types – negotiable and non-negotiable. The non-negotiable constraints are those that must be adhered to while as a designer you may have some scope for manipulating the negotiable components. In the context of pedagogical designs, the non-negotiable constraints are given – a context or situation that you as

instructional designer have little or no control. So, while designing you have to take care of these to create optimum learning scenario using communication technology. You need to be creative in each situation to design the nest possible learning environment. Creativity here does not mean original. To become creative is to know the previous works in the area and the ability to see connections and relationships in a new way. So, pedagogical design as a creative activity/process requires your in-depth and critical understanding of learning process, instructional methods, and media and technologies available to creatively weave together possible solutions as designs for specific purpose and context. The design process in therefore never final; it remains an iterative process with incremental development through experimentation and experience. So, pedagogical designs are also never static. These are dynamic models that can be sued creatively.

Check Your Progress 3.1

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

b) Compare your answers with those given at the end of this Unit.

- 1) List the four basic assumptions of instructional design.

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- 2) Why pedagogical design is a creative process?

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3.3 PEDAGOGICAL DESIGN: PROCESS

When we consider pedagogical design as a creative process, then it becomes imperative to discuss this in its context. As discussed earlier, design is specific to the opportunities and constraints of a specific situation, and therefore each teacher or for that matter each programme will have its unique design challenge. As a designer or teacher responsible for designing the system, you must justify the design. In this section we will discuss in brief three different scenario and their generic features to help you design specific pedagogical designs.

In Classroom

The classroom is our conventional benchmark for all educational transactions. Most of the education received in the formal setting is from the classroom from elementary to the higher degrees. The overall setting is the same with minor difference in the access to technology and the characteristics of the learners and the subject taught. The curriculum is defined, and given to the teacher who prepares the lesson plans, and delivers the content using different pedagogical designs. It is at this stage the teacher decides what design to bank upon depending on the subject matter

and the facilities available. In our context of communication technology, depending upon the availability the teacher can make use of audio, video, computer (for presentation as well practical work by learners individually or in group), the Web, etc. So, the use of communication technology in the classroom becomes more instructor-led, but still it can be collaborative, problem solving and discovery based. So, the teacher decides the methods and media to be used, and how to deploy these effectively. Learners may have to be oriented to the instructional approaches adopted by the teacher, and use of different designs help the teacher to make the learner more attentive, interested and motivated to learn.

In Distance Learning

Distance Education has its own uniqueness as an asynchronous learning system that has been slowly adopting methods of synchronous learning through the use of communication technology. As you know, it is a technology-mediated teaching and learning system, where teachers and learners are at a distance. The learning milieu of the student could be home or office, with access to technology or not. So, while using communication technology in the pedagogical designs, it is important to assess the access or provide access to technology as the study centres or some other facilities near the office/home of the learner. While this is a pre-requisite, distance learning can use a variety of communication media and technology, and the media mix are normally decided by the team of experts. The software is developed by a team to ensure quality. The role of a teacher may be reduced to just a coordinator or someone who is responsible for vetting the quality of the content that goes into the software. The content is normally a pre-designed package of materials in different media, including print. These materials are sent to the learners, who attend occasional face-to-face counseling at study centres, and may also attend to practical and synchronous teleconference sessions. The pedagogical design process pertains to all these stages in the distance learning, starting from the curriculum design to course development to delivery of the course. It is important to note that some of these can be standardized, while others have to be left open-ended to facilitate the creativity of the tutors and teachers in the counseling sessions and the teleconference sessions.

In Online Learning

Online learning environments provide us the best of both synchronous and asynchronous learning opportunity without the learners and teacher being present in the same physical place like that of the classroom learning environment. Thus, it provides the best interaction and learning affordances possible with the use of appropriate communication technologies. These technologies range from simple audio available online to use of sophisticated simulation and virtual worlds that re-create real situations. Thus, the possibilities are enormous, but the challenges are many. The pedagogical design process shall have to take into account *a priori* model as well as *iterative* model that can be adapted/adopted to change as the course progress. As designer of the online system, you need to consider the media mix, and its delivery through an appropriate Learning Management System (LMS), and decide the level of interaction to be provided. It has been observed that the more the interaction between the learner and the student, and the tutor assessed activities in the programme, the more workload for the teacher. That means the design has to consider the number of teachers required in teaching-learning and delivery of the programme unlike the classroom or the distance learning. While the online learning environment provides

opportunity to you to think different pedagogical designs, it may be useful to consider suitable designs useful for the course in the overriding principles of constructivist learning framework, as it is considered the most useful one. In the next section in the unit, we will discuss many pedagogical designs, but online lecture using synchronous tools can also be considered as an alternate pedagogical design that we have not discussed as lecture method is all pervasive. We will discuss about online learning/e-learning in Unit-9 where you may like to use the discussions of pedagogical designs.

Check Your Progress 3.2

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

b) Compare your answer with the one given at the end of this Unit.

Describe the pedagogical design process in distance learning in about 150 words.

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3.4 SOME TYPICAL PEDAGOGICAL DESIGNS

Over the years, a number of different pedagogical designs have been tried out in the field of education with varying degrees of success. A deep understanding of these pedagogical designs would be of much use for you as a distance education practitioner. To facilitate the same, a few important pedagogical designs are presented below as examples. A word of caution here is that besides the following, there are a number of pedagogical designs with little or more variations from the ones discussed here are available for use.

3.4.1 Anchored Video Instruction

Anchored Instruction is a learning strategy that situates or “anchors” instruction in a realistic case-study, or problem-solving situation. Anchored Instruction challenges and motivates learners to find the story’s embedded data thru a realistic, narrative, storyline format. Learners use this data to solve complex and interconnected sub-problems within the “macro-context,” by employing problem solving and critical thinking skills. Consequently, learners generate the solution that will ultimately be the story’s ending. Learners tend to transfer skills and link subject matter to other contexts as a result of Anchored Instruction’s realistic story settings, characters and events (Crews et al, 1997).

The anchored instruction approach is an attempt to help students become more actively engaged in learning by situating or anchoring instruction around an interesting topic. The learning environments are designed to provoke the kinds of thoughtful engagement that helps students develop effective thinking skills and attitudes that contribute to effective problem solving and critical thinking.

The principles of anchored instruction are

- Learning and teaching activities should be designed around an “anchor” which is often a story, adventure, or situation that includes a problem or issue to be dealt with that is of interest to the students.
- Instructional materials should include rich resources that students can explore as they try to decide how to solve a problem (e.g., interactive videodisc programs).

Anchored instruction emphasizes the need to provide students with opportunities to think about and work on problems, which is an emphasis of cognitive constructivists. Anchored instruction also emphasizes group or collaborative problem solving, which is an emphasis of social constructivists.

Anchored Instruction’s model uses seven interwoven and interdependent cognitive and instructional design principles to create instruction:

- 1) **Generative learning format** enhances learner motivation by allowing learners to create or “generate” the story’s ending by solving open-ended problems.
- 2) **Video-based presentation** improves on text book learning by adding related background information, animation, graphics, audio, simulation, rich colors and realism.
- 3) **Narrative format** enhances the story’s setting, characters, initial and ending events that enrich the realism and authenticity of the storyline.
- 4) **Problem complexity** increases learner’s interests and requires full commitment to follow interrelated steps to solve the problem.
- 5) **Embedded data designs** add the storyline with both needed and unneeded data. As a result, learners become engaged in the exploration and discovery process to identify the problem and search for the pertinent data.
- 6) **Opportunities for transfer** are created by offering the same subject, such as geometry, within three different, realistic settings that allows learners to view other opportunities to use learned skills and knowledge.
- 7) **Links across the curriculum** are rooted within a realistic story line, with content that applies to other areas of study. Therefore learners are exposed to these new subject matters that may broaden their views to explore other studies of interest.

The Anchored Instruction model was developed between the late 1980s and early 1990s by the Cognition and Technology Group at Vanderbilt University, lead by John Bransford. The Jasper Woodbury series of adventures, which were created by the group at Vanderbilt University, tell interesting stories in which there are problems to be solved. The Jasper Woodbury Problem Solving Series was designed for 5th grade students and above, to help improve their math, science and group collaboration skills. Titled as the “Adventures of Jasper Woodbury”, this video-based, instructional package contains 12 stories. The stories cover various topics and areas of study in realistic settings that focus on exploration, problem solving and critical thinking skills (Bransford, 1989).

Within Jasper’s typical problem-solving story line, there is a complex problem that has about a dozen steps learners will take to solve it. As the embedded data is presented, learners have the option to record the data or replay the video to find it. A typical video is approximately 17 minutes. Video pauses are at predetermined moments, within the story, for learners to

answer intermediate questions and find solutions. Learners will need these solutions to put together the answer to the larger, more complex question, which also creates the story's ending. More than one solution is okay, and focus is on group problem solving.

The Jasper adventures go well beyond the "word problems" typically found in math textbooks for the middle grades. Jasper adventures use a visual story format to present problems. Students watch video segments from a videodisc to understand the situation and the problem. The materials available to the students also have "embedded data" and "embedded teaching" to seed the environment with ideas relevant to problem solving.

Yet another example for Anchored Instruction is "The Voyage of the Mimi", which was developed by Bank Street College of Education, that involves students as the crew on an ocean voyage of the 72-foot ketch, Mimi, a converted French tuna trawler outfitted as a modern ocean-going vessel.

The purpose of the voyage is to study whales. It is also intended to help students develop science and mathematics skills. To successfully complete the first voyage, students must learn and use navigation principles, map reading, and many other skills.

The First Voyage of the Mimi series consists of twenty-six 15-minute programs. In the adventure story, two scientists and their teenage research assistants embark on a seagoing expedition to study humpback whales. Each drama (episode) is paired with a 15-minute documentary (expedition) that develops a scientific or mathematical concept presented in the drama. Seven videodisks support this program with video clips that illustrate different phases of the voyage as well as simulated trips to museums, aquariums, and other places where scholars study the marine life.

3.4.2 Collaborative Learning

Collaborative Learning is an umbrella term for a variety of approaches in education that involve joint intellectual effort by students or students and teachers. Collaborative learning refers to methodologies and environments in which learners engage in a common task in which each individual depends on and is accountable to each other. Groups of students work together in searching for understanding, meaning or solutions or in creating an artifact of their learning such as a product. The approach is closely related to cooperative learning. Cooperative or collaborative learning is a team process where members support and rely on each other to achieve an agreed-upon goal. Collaborative learning activities vary widely, but most centre on students' exploration or application of the course material, not simply the teacher's presentation or explication of it. Collaborative learning represents a significant shift away from the typical teacher-centered or lecture-centered milieu in college classrooms. In collaborative classrooms, the lecturing/ listening/note-taking process may not disappear entirely, but it lives alongside other processes that are based in students' discussion and active work with the course material. Teachers who use collaborative learning approaches tend to think of themselves less as expert transmitters of knowledge to students, and more as expert designers of intellectual experiences for students as coaches or mid-wives of a more emergent learning process. Collaborative learning is a relationship among learners that requires positive interdependence (a sense of sink or swim together), individual accountability (each of us has to contribute and learn), interpersonal skills (communication, trust, leadership, decision making, and conflict resolution), face-to-face interaction, and processing (reflecting on how well the team is functioning and how to function even better).

Proponents of collaborative learning claim that the active exchange of ideas within small groups not only increases interest among the participants but also promotes critical thinking. There is persuasive evidence that cooperative teams achieve at higher levels of thought and retain information longer than learners who work quietly as individuals. The shared learning gives learners an opportunity to engage in discussion, take responsibility for their own learning become critical thinkers. Some of the important approaches to collaborative learning are as follows:

- 1) Learning is an active process whereby learners assimilate the information and relate this new knowledge to a framework of prior knowledge.
- 2) Learning requires a challenge that opens the door for the learner to actively engage his/her peers, and to process and synthesize information rather than simply memorize and regurgitate it.
- 3) Learners benefit when exposed to diverse viewpoints from people with varied backgrounds.
- 4) Learning flourishes in a social environment where conversation between learners takes place. During this intellectual gymnastics, the learner creates a framework and meaning to the discourse.
- 5) In the collaborative learning environment, the learners are challenged both socially and emotionally as they listen to different perspectives, and are required to articulate and defend their ideas. In so doing, the learners begin to create their own unique conceptual frameworks and not rely solely on an expert's or a text's framework.

Thus, in a collaborative learning setting, learners have the opportunity to converse with peers, present and defend ideas, exchange diverse beliefs, question other conceptual frameworks, and are actively engaged.

Collaborative Learning is instruction that involves students working in teams to accomplish a common goal, under conditions that include the following elements (Johnson, Johnson, and Smith, 1991):

- 1) **Positive interdependence.** Team members are obliged to rely on one another to achieve the goal. If any team members fail to do their part, everyone suffers consequences.
- 2) **Individual accountability.** All students in a group are held accountable for doing their share of the work and for mastery of all of the material to be learned.
- 3) **Face-to-face interaction.** Although some of the group work may be divided and done individually, some must be done interactively, with group members providing one another with feedback, challenging one another's conclusions and reasoning, and perhaps most importantly, teaching and encouraging one another.
- 4) **Appropriate use of collaborative skills.** Students are encouraged and helped to develop and practice trust-building, leadership, decision-making, communication, and conflict management skills.
- 5) **Group processing.** Team members set group goals, periodically assess what they are doing well as a team, and identify changes they will make to function more effectively in the future.

Collaborative learning is not simply a synonym for students working in groups. A learning exercise only qualifies as collaborative learning to the extent that the above listed elements are present. From various sources, the following list of advantages of collaborative learning has been drawn:

- 1) Develops higher level thinking skills
- 2) Promotes student-faculty interaction and familiarity
- 3) Increases student retention
- 4) Builds self esteem in students
- 5) Enhances student satisfaction with the learning experience
- 6) Promotes a positive attitude toward the subject matter
- 7) Develops oral communication skills
- 8) Develops social interaction skills
- 9) Promotes positive race relations
- 10) Creates an environment of active, involved, exploratory learning
- 11) Uses a team approach to problem solving while maintaining individual accountability
- 12) Encourages diversity understanding
- 13) Encourages student responsibility for learning
- 14) Involves students in developing curriculum and class procedures
- 15) Students explore alternate problem solutions in a safe environment
- 16) Stimulates critical thinking and helps students clarify ideas through discussion and debate
- 17) Enhances self management skills
- 18) Fits in well with the constructivist approach
- 19) Establishes an atmosphere of cooperation and helping school-wide
- 20) Students develop responsibility for each other
- 21) Builds more positive heterogeneous relationships
- 22) Encourages alternate student assessment techniques
- 23) Fosters and develops interpersonal relationships
- 24) Modelling problem solving techniques by students' peers
- 25) Students are taught how to criticize ideas, not people
- 26) Sets high expectations for students and teachers
- 27) Promotes higher achievement and class attendance.
- 28) Students stay on task more and are less disruptive
- 29) Greater ability of students to view situations from others' perspectives (development of empathy)
- 30) Creates a stronger social support system
- 31) Creates a more positive attitude toward teachers, principals and other school personnel by students and creates a more positive attitude by teachers toward their students
- 32) Addresses learning style differences among students
- 33) Promotes innovation in teaching and classroom techniques
- 34) Classroom anxiety is significantly reduced
- 35) Test anxiety is significantly reduced
- 36) Classroom resembles real life social and employment situations
- 37) Students practice modeling societal and work related roles
- 38) Collaborative learning is synergistic with writing across the curriculum
- 39) Collaborative learning activities can be used to personalize large lecture classes
- 40) Skill building and practice can be enhanced and made less tedious through CL activities in and out of class.

- 41) Collaborative learning activities promote social and academic relationships well beyond the classroom and individual course
- 42) Collaborative learning processes create environments where students can practice building leadership skills.
- 43) Collaborative learning increases leadership skills of female students
- 44) In educational institutions where students commute to classes and do not remain on campus to participate in campus life activities, collaborative learning creates a community environment within the classroom.

Collaborative Learning Techniques

- **Think-Pair-Share:** (1) The instructor poses a question, preferable one demanding analysis, evaluation, or synthesis, and gives students about a minute to think through an appropriate response. This “think-time” can be spent writing, also. (2) Students then turn to a partner and share their responses. (3) During the third step, student responses can be shared within a four-person learning team, within a larger group, or with an entire class during a follow-up discussion. The caliber of discussion is enhanced by this technique, and all students have an opportunity to learn by reflection and by verbalization.
- **Three-Step Interview:** Common as an ice-breaker or a team-building exercise, this structure can also be used also to share information such as hypotheses or reactions to a film or article. (1) Students form dyads; one student interviews the other. (2) Students switch roles. (3) The dyad links with a second dyad. This four-member learning team then discusses the information or insights gleaned from the initial paired interviews.
- **Simple Jigsaw:** The faculty member divides an assignment or topic into four parts with all students from each LEARNING TEAM volunteering to become “experts” on one of the parts. EXPERT TEAMS then work together to master their fourth of the material and also to discover the best way to help others learn it. All experts then reassemble in their home LEARNING TEAMS where they teach the other group members.
- **Roundtable:** Roundtable structures can be used to brainstorm ideas and to generate a large number of responses to a single question or a group of questions.
 - Faculty poses question.
 - One piece of paper and pen per group.
 - First student writes one response, and says it out loud.
 - First student passes paper to the left, second student writes response, etc.
 - Continues around group until time elapses.
 - Students may say “pass” at any time.
 - Group stops when time is called.

The key here is the question or the problem you’ve asked the students to consider. It has to be one that has the potential for a number of different “right” answers. Relate the question to the course unit, but keep it simple so every student can have some input. Once time is called, determine what you want to have the students do with the lists. They may want to discuss the multitude of answers or solutions or they may want to share the lists with the entire class.

- **Focused Listing:** Focused listing is used as a brainstorming technique and also as a technique to generate descriptions and definitions for concepts. Focused listing asks the students to generate words to define or describe something. Once students have completed this activity, you can use these lists to facilitate group and class discussion. Example: Ask students to list 5-7 words or phrases that describe or define what a motivated student does. From there, you might ask students to get together in small groups to discuss the lists, or to select the one that they can all agree on. Combine this technique with a number of the other techniques and you can have a powerful collaborative learning structure.
- **Structured Problem-Solving:** Structured problem-solving can be used in conjunction with several other cooperative learning structures.
 - Have the participants brainstorm or select a problem for them to consider.
 - Assign numbers to members of each group (or use playing cards). Have each member of the group be a different number or suit.
 - Discuss task as group.
 - Each participant should be prepared to respond. Each member of the group needs to understand the response well enough to give the response with no help from the other members of the group.
 - Ask an individual from each group to respond. Call on the individual by number.

From the foregoing discussion on different collaborative learning techniques, you might have understood that at their best, collaborative classrooms stimulate both students and teachers. Learning collaboratively demands responsibility, persistence and sensitivity, but the result can be a community of learners in which everyone is welcome to join, participate and grow.

Check Your Progress 3.3

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

b) Compare your answers with those given at the end of this Unit.

1) Write the two basic principles of Anchored Video Instruction.

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.....

2) Write True or False.

- a) Collaborative learning is a team effort where members rely on each other.
- b) Collaborative learning does not help in developing social skills.
- c) Collaborative learning helps students to develop critical thinking.
- d) Think-Pair-Share is an example of collaborative learning.

3.4.3 Problem-based Learning

Problem-based Learning (PBL) was developed in the mid-1960s as a useful instructional alternative to conventional teaching. It originated in medical education and was introduced because many students in medical education could not see the relevance of first-year course material (e.g., anatomy, physiology, or biochemistry) to their future professions as medical doctors. Students were looking forward to working with real patients and trying to solve their problems, which typically does not happen until the internships. This led to disappointment among students as well as difficulties with integrating subject matter of different medical disciplines. The medical school of McMaster University in Hamilton, Canada was the first to tackle these issues and they designed an instructional format that made use of “problems” that reflected realistic medical problems that physicians encounter. However, the use of problems in education was not new since some Law and Business schools had long been using real-life problems. Problem-based Learning’s “creative” element was the moment at which students encountered such problems. At McMaster, students started to work with problems before they had acquired any significant knowledge of the topic at hand, which differed from the situation in Law and Business schools where problems were encountered and solved after some competence was achieved. In other words, PBL distinguished itself by making problems a starting point of the learning process. It is assumed that Donald Woods of McMaster University Medical School was the first to use the term “problem-based learning. Since its origin, problem-based Learning has been implemented in numerous courses across many domains such as Law, Economics, Business Administration, Social Sciences, and even in secondary education.

Problem-based learning (PBL) is a student-centered instructional strategy in which students collaboratively solve problems and reflect on their experiences. Finkle and Torp (1995) state that “problem-based learning is a curriculum development and instructional system that simultaneously develops both problem solving strategies and disciplinary knowledge bases and skills by placing students in the active role of problem solvers confronted with an ill-structured problem that mirrors real-world problems”. Characteristics of PBL are:

- Learning is driven by challenging, open-ended problems.
- Students work in small collaborative groups.
- Teachers take on the role as “facilitators” of learning.

Accordingly, students are encouraged to take responsibility for their group and organize and direct the learning process with support from a tutor or instructor. Advocates of PBL claim it can be used to enhance content knowledge and foster the development of communication, problem-solving, and self-directed learning skill. Problem-based learning (PBL) is typically organized with small groups of learners, accompanied by an instructor, faculty person, or facilitator. During this process, a series of problems are provided to learners with guidance early in the PBL process (with introductory problems), and then later guidance is faded as learners gain expertise. Guidance is faded as group members feel more confident with the subject matter and become more competent with the learned procedures. Specific tasks in a problem-based learning environment include:

- determining whether a problem exists;
- creating an exact statement of the problem;

- identifying information needed to understand the problem;
- identifying resources to be used to gather information;
- generating possible solutions;
- analyzing the solutions; and
- presenting the solution, orally and/or in writing.

The acquisition and structuring of knowledge in PBL is thought to work through the following cognitive effects:

- initial analysis of the problem and activation of prior knowledge through small-group discussion
- elaboration on prior knowledge and active processing of new information
- restructuring of knowledge, construction of a semantic network
- social knowledge construction
- learning in context
- stimulation of curiosity related to presentation of a relevant problem

Some theories suggest that learning occurs as students collaboratively engage with concepts in meaningful problem solving. In this view, knowledge is seen as a tool for thinking and for enabling learners to participate in meaningful activity. Problem-based learning is often referred to as a form of Inquiry-based Learning (IBL), which describes an environment in which learning is driven by a process of inquiry owned by the student.

As you would have understood by now problem-based learning (PBL) is an instructional method that challenges students to “learn to learn,” working cooperatively in groups to seek solutions to real world problems. These problems are used to engage students’ curiosity and initiate learning the subject matter. PBL prepares students to think critically and analytically, and to find and use appropriate learning resources.

3.4.4 Discovery Learning

Discovery learning has various definitions. At one end of the spectrum we find discovery learning in its simplest form. The tools and information needed to solve a problem or learn a concept are provided and the learner “makes sense” of them. Another definition is discovery learning as experimentation with some extrinsic intervention - clues, coaching, and a framework to help learners get to a reasonable conclusion. At the other end of the continuum is the expository teaching model of discovery learning where the learner “discovers” what the teacher decides he is to discover using a process prescribed by the teacher.

Jerome Bruner is thought to have originated discovery learning in the 1960s, but his ideas are very similar to those of earlier writers like John Dewey. Bruner argues that “Practice in discovering for oneself teaches one to acquire information in a way that makes that information more readily viable in problem solving” (Bruner, 1961). This philosophy later became the discovery learning movement of the 1960s. The mantra of this philosophical movement suggests that we should ‘learn by doing’. Discovery Learning is an inquiry-based learning method. The concept of discovery learning has appeared numerous times throughout history as a part of the educational philosophy of many great philosophers particularly Rousseau, Pestalozzi and Dewey. “There is an intimate and necessary relation between the processes of actual

experience and education” wrote Dewey. It also enjoys the support of learning theorists and psychologists Piaget, Bruner, and Papert. Jerome Bruner lays out two targets for discovery learning theory:

- Discovery Learning Theory should act as a refined extension of the broad based theory of constructivism by focusing on the individual.
- Discovery Learning Theory should serve as a way of defining and providing structure to the way in which individuals learn thus acting as a guide for educational research.

There are four components to the Discovery Learning Theory:

- 1) Curiosity and uncertainty
- 2) Structure of knowledge
- 3) Sequencing
- 4) Motivation

There are three principles associated with Discovery Learning Theory:

- Instruction must be concerned with the experiences and contexts that make the student willing and able to learn (readiness).
- Instruction must be structured so that it can be easily grasped by the student (spiral organization).
- Instruction should be designed to facilitate extrapolation and or fill in the gaps (going beyond the information given).

The discovery learning mode requires that the student participates in making many of the decisions about what, how, and when something is to be learned and even plays a major role in making such decisions. Instead of being ‘told’ the content by the teacher, it is expected that the student will have to explore examples and from them ‘discover’ the principles or concepts, which are to be learned. Discovery learning takes place in problem solving situations where the learner draws on his own experience and prior knowledge to discover the truths that are to be learned and is a method of instruction through which students interact with their environment by exploring and manipulating objects, wrestling with questions and controversies, or performing experiments. It is a personal, internal, constructivist learning environment. Bruner wrote “Emphasis on discovery in learning has precisely the effect on the learner of leading him to be a constructionist, to organize what he is encountering in a manner not only designed to discover regularity and relatedness, but also to avoid the kind of information drift that fails to keep account of the uses to which information might have to be put” (Bruner, 1961). Students interact with the world by exploring and manipulating objects, wrestling with questions and controversies, or performing experiments. As a result, students may be more likely to remember concepts and knowledge discovered on their own (in contrast to a transmissionist model). Models that are based upon discovery learning model include: guided discovery, problem-based learning, simulation-based learning, case-based learning, incidental learning, among others. Proponents of this theory believe that discovery learning has many advantages, including:

- encourages active engagement
- fosters curiosity
- enables the development of lifelong learning skills
- personalizes the learning experience
- promotes motivation

- promotes autonomy, responsibility, independence
- the development of creativity and problem solving skills
- is a tailored learning experience
- builds on the student's prior knowledge and understanding

While we understand that discovery learning is a sound pedagogical design, we must also be aware that there are potential disadvantages in it. Discovery learning may confuse the student, if no initial framework is available, be inefficient and time consuming and teachers may fail to detect problems and misconceptions while practicing discovery learning.

3.4.5 Scenario-based Learning

Scenario-based Learning (SBL) refers to learning based on context or situations and social frameworks. It is based on concept of situated cognition. Situated cognition is a relation between an individual and a social and/or physical situation. In line with the observation of Orey and Nelson (1997), scenario-based learning works on the basic premise that knowledge cannot be known and fully understood independent of its context. Context is a pervasive and potent force in any learning event. Yet instructional design models contain little guidance about how to accommodate contextual elements to improve learning and transfer. On the other hand, scenario-based learning firmly believes in the powerful role that the context can play in facilitating learning. The basic assumptions of the role of context in the instructional design of scenario-based learning are as follows:

- Context is an influential and inevitable part of every learning experience.
- Context is a medley of factors that inhibit or facilitate learning to varying degrees.
- There may be multiple contexts for a given learning or performance.
- Instructional designs can accommodate context, but cannot control it.
- The impact of context varies with the nature of the learner, the content, and the intensity of the contextual elements.
- Successful instructional designs must be, to a great extent, situation-specific.
- Instructional designers are responsible for the successful application as well as acquisition of learning, and therefore must respond to orienting and performance contexts as well as instructional contexts.

Scenario-based learning puts the student in a situation or context and exposes them to issues, challenges and dilemmas and asks them to apply knowledge and practice skills relevant to the situation. The student navigates through by choosing options and is given feedback based upon their choice.

Scenario-based learning occurs by following a series of success and failure paths through a realistic situation based on achieving the main learning objective. It is important to establish the boundaries of the scenarios. These are done using behaviour-based learning objectives as opposed to knowledge-based learning objectives.

- Scenarios are most effective when they have a game-like appearance.
- It accords with a performance improvement and behaviour change philosophy of the learning function.
- Remediation (learner feedback) is essential to successful Scenario-based learning.

- Scenario-based learning can:
 - o Reinforce learning
 - o Establish gaps in learning
 - o Overcome learning blocks
 - o Change behaviour
 - o Prepare students for panel observation
 - o Save time and/or money by replicating complex or expensive experiments.

Scenario is the description of a task or a job situation from the learner's perspective. A sequence of concrete problems is described and choices are presented that enable the learners to reach a satisfactory outcome. The key to success is the learner's situational awareness and judgment. Scenario-based learning differs from other forms like drill and practice in that it requires the selection of responses to move through the lessons, instead of content answers to questions. It supplies information only needed. As a result, it focuses on performance improvement rather than correct answers. It exposes the learners to a situation outlined in a scenario and makes the learner apply their knowledge relevant to that situation by making choices and attempting to follow a desirable path that demonstrates their ability to achieve a successful outcome. Instead of right or wrong answers, there are success and failure paths.

Scenario-based learning takes the form of a storyline in which learners are required to assume a key role. The roles need to be carefully selected, preferably something that a learner might actually perform in real life. Supporting materials and resources in the form of readings, and other forms of resource materials can wrap around the scenario for deeper understanding of the concepts. A well designed scenario can offer learners and teachers a highly interactive and engaging learning and teaching environment that is imperative in open and distance educational settings. The scenario-based learning can be used for teaching of any kind of subject matter, at any level of education and training and via any delivery mode. However, experience in scenario-based learning indicates that it has particular advantages for practice-based discipline areas where the experience of practitioners is especially relevant to what constitutes knowledge and understanding in the field. Scenario-based learning is widely in practice in the world of e-learning.

3.4.6 Case-based Learning

Case-based learning focuses on the building of knowledge and the group works together to examine the case. The instructor's role is that of a facilitator and the students collaboratively address problems from a perspective that requires analysis. Much of case-based learning involves learners striving to resolve questions that have no single right answer. This method is learner-centered, and involves intense interaction between the participants. Using a case-based approach engages students in discussion of specific situations, typically real-world examples.

The use of case studies holds great promise as a pedagogical technique for teaching. Many faculty use case studies in their curriculum to teach content, involve students with real life data to provide opportunities for students to put themselves in the decision maker's shoes.

Cases add meaning by providing students with the opportunity to see theory in practice. Real world or authentic contexts expose students to

viewpoints from multiple sources and see why people may want different outcomes. Students can also see how a decision will impact different participants, both positively and negatively.

Cases usually require students to analyze data in order to reach a conclusion. Since many assignments are open-ended, students can practice choosing appropriate analytic techniques as well. Instructors who use case-based learning say that their students are more engaged, interested, and involved in the class.

In their effort to find solutions and reach decisions through discussion, students sort out factual data, apply analytic tools, articulate issues, reflect on their relevant experiences, and draw conclusions they can relate to new situations. In the process, they acquire substantive knowledge and develop analytic, collaborative, and communication skills.

Cases are important for bringing real world problems into a classroom or a workshop. They ensure active participation and may lead to innovative solutions to problems. The Formats for Cases are as follows:

- *“Finished” cases based on facts*—for analysis only, since the solution is indicated or alternate solutions are suggested.
- *“Unfinished” open-ended cases*, where the results are not yet clear (either because the case has not come to a factual conclusion in real life, or because the instructor has eliminated the final facts.) Students must predict, make choices and offer suggestions that will affect the outcome.
- *Fictional cases* entirely written by the instructor—can be open-ended or finished. Cautionary note: the case must be both complex enough to mimic reality, yet not have so many “red herrings” as to obscure the goal of the exercise.
- *Original documents*—news articles, reports with data and statistics, summaries, excerpts from historical writings, artifacts, literary passages, video and audio recordings, ethnographies, etc. With the right questions, these can become problem-solving opportunities. Comparison between two original documents related to the same topic or theme is a strong strategy for encouraging both analysis and synthesis. This gives the opportunity for presenting more than one side of an argument, making the conflicts more complex.

The different types of cases along with brief descriptions are presented below for your understanding:

- 1) Extensive, detailed case study.
 - Frequently used in business courses,
 - Often center on a particular decision, the people who made it, the people affected by it, and the impact of that decision on all parties.
 - May run 100 pages or more. Usually the student reads the entire case individually and prepares an analysis of the decisions with recommendations for change. The case is then discussed.
- 2) Descriptive, narrative cases, parts of which are given successively
 - Up to 5 pages
 - 1-2 paragraphs per page
 - Designed to be used over the course of two or more class meetings.
 - Disclosed to the students one page at a time, with discussion, hypothesis generation and development of learning goals and study questions for each part of the case.

- Objectives are given to the student toward the end of the case.
 - This style of case originated in medical settings.
- 3) Mini Cases
- designed to be used in a single class meeting,
 - usually tightly focused.
 - useful for helping students apply concepts, for introducing practical applications in lab settings, or as a pre-lab exercise designed to make lab work more meaningful.
- 4) Bullet Cases
- Two or three sentences with a single teaching point.
 - Similar to problems commonly used on exams, however, students discuss them in small groups.
- 5) Directed Case Study
- Short cases are followed immediately with highly directed questions.
- 6) Fixed Choice Options (Multiple Choice Cases)
- May be a variation on bullet cases above,
 - Is a minicase with 4-5 plausible solutions. In groups students must choose and defend one solution.
 - Useful for policy, ethics, design decisions.
 - Good for short, in-class uses.
 - Multiple choice questions might convert easily to these.

The characteristics of a good case are as follows:

- A good case tells a story. (It must have an interesting plot that relates to the experiences of the audience. It must have a beginning, a middle, and an end. The end may not exist yet; it will be what the students need to supply once the case is discussed.)
- A good case focuses on an interest-arousing issue.
- A good case is set in the context of current relevance.
- A good case creates empathy with the central characters.
- A good case includes quotations.
- A good case is relevant to the reader.
- A good case must have pedagogic utility.
- A good case is decision forcing.
- A good case has generality.
- A good case is short.

The methods of managing a Case assignment are as follows:

- Design discussions for small groups: 3-6 students are an ideal group size for setting up a discussion on a case.
- Design the narrative or situation such that it requires participants to reach a *judgment, decision, recommendation, prediction or other concrete outcome*. If possible, require each group to reach a consensus on the decision requested.
- Structure the discussion. The instructor should provide a series of written questions to guide small group discussion. Pay careful attention to the sequencing of the questions. Early questions might ask participants to make observations about the facts of the case. Later

questions could ask for comparisons, contrasts, and analyses of competing observations or hypotheses. Final questions might ask students to take a position on the matter. The purpose of these questions is to stimulate, guide or prod (but not dictate) participants' observations and analyses. The questions should be impossible to answer with a simple yes or no.

- Debrief the discussion to compare group responses. Help the whole class interpret and understand the implications of their solutions.
- Allow groups to work without instructor interference. The instructor must be comfortable with ambiguity and with adopting the non-traditional roles of witness and resource, rather than authority.

3.4.7 Learning by Designing

When people think about learning and education, they often think about one person transmitting information to another. Increasingly, educators are recognizing that this "transmission approach" doesn't work very well. Research has shown that people learn best not when they are passively receiving information, but when they are actively engaged in exploring, experimenting, and expressing themselves. More and more schools are focusing on learning-by-doing, engaging students in hands-on activities. Students are made to simply get their hands on computers; they use computers to design, create, and invent things. It's not just learning by-doing; it's learning-by-designing.

Learning by designing approach is inspired by two important theories of learning and education viz., the constructivist theory of learning and the constructionist approach to education. The constructivist theory of learning, developed by Swiss psychologist Jean Piaget, views learning as a very active process in which people continually construct new knowledge from their experiences in the world. According to this theory, people don't get ideas, they make them. Constructivist theory is the underpinning for many educational reform initiatives. The constructionist approach to education, developed by Seymour Papert, is based on two types of construction: it argues that people construct new knowledge especially well when they are engaged in constructing things in the world. They might be constructing sand castles or computer programs. What's important is that they are actively engaged in creating something meaningful to themselves or others around them.

The reasons for and the advantages of use of learning-by-doing approach are as follows:

- Design projects engage kids as active participants, giving them a greater sense of control and responsibility for the learning process.
- Design projects encourage creative problem-solving.
- Design projects are often interdisciplinary, bringing together ideas from art, technology, math, and sciences.
- Design projects help kids learn to put themselves in the minds of others, since they need to consider how others will use the things they create.
- Design projects provide opportunities for reflection and collaboration.
- Design projects set up a positive-feedback loop of learning: when kids design things, they get new ideas, leading them to design new things, from which they get even more ideas, leading them to design yet more things.

3.4.8 Self Learning

Self-Learning is otherwise known as Self Directed Learning (SDL) and Self Regulated Learning. In self-directed learning (SDL), the individual takes the initiative and the responsibility for what occurs. Self-directed learning has been described as “a process in which individuals take the initiative, with or without the help of others,” to diagnose their learning needs, formulate learning goals, identify resources for learning, select and implement learning strategies, and evaluate learning outcomes. Individuals select, manage, and assess their own learning activities, which can be pursued at any time, in any place, through any means, at any age. For the individual, SDL involves initiating personal challenge activities and developing the personal qualities to pursue them successfully. Self-directed Learning includes the learner initiating the learning, making the decisions about what training and development experiences will occur, and how. The learner selects and carries out their own learning goals, objectives, methods and means to verifying that the goals were met. Self-directed learning becomes even more powerful when it's systematic, that is, when we decide:

- 1) What areas of knowledge and skills we need to gain in order to get something done (our learning needs and goals)?
- 2) How we will gain the areas of knowledge and skills (our learning objectives and activities)?
- 3) How we will know that we've gained the areas of knowledge and skills (learning evaluation)?

Elements of Self-Directed Learning

The first element is student control over as much of the learning experience as possible. The major shift from teacher directed learning to self directed learning is a shift in the locus of control from the teacher to the student. For the student, this represents a shift from outer control to inner control. Such a shift reflects the major change underway in the lives of adolescents as they begin to establish themselves as individuals separate from their childhood dependencies. During these years they begin to shape their own opinions and ideas, to make their own decisions, choose their own activities, take more responsibility for themselves and begin to work. Charging students with the task of developing their own learning, turns them to their own resources, which develops their emerging individuality and helps them to rehearse more adult roles.

The second element of SDL is skill development. Inner control is aimless unless students learn to focus and apply their talents and energies intensely. For this reason the emphasis in SDL is on the development of skills and processes that lead to productive activity. Students learn to achieve course outcomes, to think independently and to plan and execute their own activities. These processes, and the skills involved in them, come together in student proposals for study and action. They prepare and then negotiate them with their teachers, often in the form of written agreements, which become records of the contracts that they negotiate. The intent is to provide a framework that enables students to identify their interests and equips them to realize them successfully.

The third element is students learning to challenge themselves to their best possible performance. Self-direction is dormant without challenge. First teachers challenge students and then they challenge them to challenge themselves. Challenge involves reaching for a new level of performance in a familiar field or launching an adventure into a new field of interest. It means

setting the standard of achievement a step higher than one can readily achieve. Challenging oneself means taking the risk to go beyond the easy and familiar. For those willing, it means reaching regularly for performances that demand from them the very best they have to offer. The challenge is to go out far and in deep: it is the challenge of the hero's journey.

The fourth element is student self-management, management of themselves and of their learning enterprises. In SDL choices and freedoms are matched by self-control and responsibilities. Students learn to express self-control by searching for, and making a commitment to, core personal interests and aspirations. In this process they determine not only what they will do but the kind of performer they will become. SDL requires confidence, courage and determination to energize the effort involved. Students develop these attributes as they become skilled in managing their own time, effort and the resources they need to conduct their work. Even well organized efforts run aground. In the face of obstacles, students learn to face their difficulties, find alternatives and solve their problems in order to maintain effective productivity. The combination of inner resources and performative skill required for self-management in SDL is the same process students will require for the successful management of growth and productivity throughout their lives.

The fifth element is that students motivate and assess their own efforts. Many principles of motivation are built into the design of SDL, such as the pursuit of one's own high-interest goals. When students adopt these principles they become the major elements of self-motivation. By setting important goals for themselves, arranging for feedback on their work and achieving success, for example, they learn to inspire their own efforts. Similarly, students learn to evaluate their own progress. They plan the method by which their work will be assessed and usually negotiate the terms with the teachers. These terms are often stated in the learning proposals that students present. Since the responsibility for proving that they have achieved their goals lies with students, they gather their proofs and/or products in a portfolio, which becomes the focus of evaluation. Just as self-motivation energizes students to produce the achievements that are evaluated, self-assessment motivates students to seek the best possible achievement.

Self-Regulated Learning Activities

Self-regulated learners engage recursively in a cycle of cognitive activities as they work through a given task. To begin, self-regulated learners analyze task demands. When presented with a history report, for example, a self-regulated learner examines cues to determine what is required. The student might review notes from a teacher's verbal instructions or scrutinize assignment descriptions to extract information regarding the topic, expected procedures, required products, and/or marking criteria. As part of this process, the student would draw on his or her prior knowledge about what makes a good "report" (i.e., "metacognitive knowledge" about the task). For example, the student might recall that, in a report, teachers expect solid research, a clear and organized presentation, and/or appropriate references. Task analysis is critical to effective self-regulation because it sets the context for further learning. Students base subsequent decisions (e.g., about strategies to use) on their perception of task demands.

Based on the requirements of a particular task, self-regulated learners then select, adapt, or even invent strategic approaches to achieve task objectives.

As in task analysis, students draw on prior knowledge and experience to make strategy decisions (i.e., metacognitive knowledge about strategies).

Once self-regulated learners implement strategies, they monitor outcomes associated with strategy use. Effective learners self-evaluate by comparing progress against task criteria to generate judgments about how they are doing. If they perceive gaps between desired and actual performance, they adjust learning activities accordingly. Effective learners also interpret externally provided feedback (e.g., marks on tests, teacher or peer comments on writing) as they self-evaluate performance. They use feedback strategically to diagnose challenges and problem solving solutions. As with task analysis, monitoring is critical to effective self-regulation. This is because, during monitoring, students generate judgments about progress and make decisions that shape further learning activities.

Characteristics of Self-Regulating Students

What characterizes the self-regulating students is their active participation in learning. Characteristics attributed to self-regulating persons coincide with those attributed to high-performance, high-capacity students as opposed to those with low performance. Studies show that the following characteristics differentiate students who self-regulate their learning from those who do not:

- 1) They are familiar with and know how to use a series of cognitive strategies (repetition, elaboration, organization etc.,) which help them to attend to, transform, organize, elaborate and recover information.
- 2) They know how to plan, control and direct their mental processes towards the achievement of personal goals.
- 3) They show a set of motivational beliefs and adaptive emotions, such as a high sense of academic self-efficacy, the adoption of learning goals, the development of positive emotion towards tasks, as well as the capacity to control and modify these, adjusting them to the requirements of the task and of the specific learning situation.
4. They plan and control the time and effort to be used on the tasks, and they know how to create and structure favourable learning environments, such as finding a suitable place to study, and help-seeking from teachers and classmates when they have difficulties.
5. They show greater efforts to participate in the control of academic tasks, classroom climate and structure.
6. They are able to put into play a series of volitional strategies, aimed at avoiding external and internal distractions, in order to maintain their concentration, effort and motivation while performing academic tasks.

In a nutshell, the self-regulating learners see themselves as agents of their own behaviour, they believe learning is a proactive process, they are self-motivated and they use strategies that enable them to achieve desired academic results.

In the context of communication technologies, the use of appropriate pedagogical designs becomes important. While self-learning is an overriding model used in distance education, the use of Anchored Video Instructions (AVI), Collaborative Learning, Case Study, and Problem-Based Learning designs can be used in both print and non-print media. While AVI and collaborative learning designs can be suitably used in teleconference, the use of problem based learning and discovery learning are suitable for multimedia and web-based learning environments. Learning by designing is

highly significant when we want to develop skills and project work experience to internship, where learners may be asked to design and project or prototype. Scenario-based learning is useful in professional courses where the learners may take a specific role, such as a teacher or teacher-educator. The exposure to these learning designs shall help you in thinking about teaching and learning using technology, and not just production of media materials. Non-print materials without thinking of how they would be delivered or used in teaching learning may not promote effective learning. You are expected to relate these learning to developments of technical skills in this course and use of production of appropriate learning materials for your students.

Check Your Progress 3.4

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

b) Compare your answer with the one given at the end of this unit.

Match the pedagogical designs in Column B with the learning scenario/subject in Column A in the best possible way.

Column A

Organizational Problems
Project Management
Hazardous situation in a Steel Plant
Topics in Dental Science
Forest and environment in a CD
Teacher Professional Development
Negotiation skills

Column B

Anchored Video Instruction
Collaborative Learning
Problem-based Learning
Discovery Learning
Scenario-based Learning
Case Study
Learning by Design

3.5 LET US SUM UP

This Unit is all about teaching and learning using technology. We used pedagogical designs in this Unit in the context of the art of teaching and the science of learning. It was emphasized that teaching is an organized act where design becomes highly important. The design or the blueprint of teaching using technology makes all the difference in learning. It is a creative process, where you are expected to have a thorough understanding of learning theories, instructional design models, teaching methods and media, and educational technologies. We also discussed some pedagogical designs in details. These are: Anchored Video Instruction, Collaborative Learning, Problem-Based Learning, Discovery Learning, Scenario-Based Learning, Case-Based Learning, Learning by Designing, Self-Learning, etc. While each one has its own unique qualities and advantages, we discussed how these can be applied in teaching and learning situations in general, including technology mediated communication technology enabled learning environments. As you progress in this course, keep these pedagogical designs in mind to think how you can use these for different kinds of technologies. Each of these demands high levels of teacher and student engagements. Though in self learning (which in most case is true for distance and online learning) the student is mostly self directed and requires little help from the teacher, we can design the systems in such a way so as to have high interaction using the designs discussed. However, as can be seen from the discussions, these designs would require more systematic planning for distance and online learning systems.

3.6 KEYWORDS

Anchored Video Instruction: is a system of instruction that uses video 'anchors' to provide authentic learning environments.

Case Based Learning: uses case studies of various types to help the student develop critical understanding of the problem, and argue in favour or against the case to give solutions/recommendations.

Collaborative Learning: is an umbrella term that involves students working in groups to accomplish common goals, where they are interdependent, but individually accountable for their action. There are various techniques of collaboration to facilitate learning.

Design: refers to a plan/document/blueprint for making something to work. It can be used as a verb or noun to show process or a product.

Discovery Learning: is a teaching and learning strategy where the teacher provides clues and the learner makes self efforts to discover knowledge.

Pedagogy: is art of teaching and science of learning. Used mostly in school level, we have used this as generic term in this unit.

Problem-based Learning: is a teaching strategy where learning is driven by challenging tasks that are given to them as problem, and the students use various methods to analyse and solve the problem. Learning happens when the student is in a position to identify the problem correctly, find appropriate solutions and suggest the right solution for the given problem.

Scenario-based Learning: refers to learning based on context or situations and social frameworks. It is mostly used in teaching professional courses, where students can be assigned specific roles to develop skills and knowledge.

3.7 REFERENCES AND FURTHER READINGS

- Bruner, Jerome (1961). The act of discovery. *Harvard Educational Review*, 31(1), 21-32.
- Crews, T., Biswas, G., Goldman, S. & Bransford, J. (1997). Anchored interactive learning environments, *Journal of Artificial Intelligence in Education*, 8, 142-178.
- Finkle, S.L., & Torp, L.L. (1995). *Introductory Documents*. (Available from the Center for Problem-Based Learning, Illinois Math and Science Academy)
- Gagné, R.M., & Briggs, L.J. (1974). *Principles of instructional design*. New York: Holt.
- Johnson, D. W., Johnson, R. T., & Smith, K. A. (1911). *Cooperative Learning: Increasing College Faculty Instructional Productivity*. ASHE-FRIC Higher Education Report No.4. Washington, D.C.: School of Education and Human Development, George Washington University.
- Orey, M. A., & Nelson, W. A. (1997). The impact of situated cognition: Instructional design paradigms in transition. In C. R. Dill & A. J. Romiszowski (Eds.), *Instructional development paradigms* (pp. 283-296). Englewood Cliffs, NJ: Educational Technology Publications.

3.8 FEEDBACK TO CHECK YOUR PROGRESS QUESTIONS

Check Your Progress 3.1

- 1) The assumptions of instructional design are:
 - a) that instructional planning must be oriented towards individual to help them develop knowledge and skills;
 - b) instructional design has phases where the teacher prepares lesson plan and executes it later;
 - c) systematically designed instruction can greatly affect individual human development; and

- d) designing instruction must be based upon knowledge of how human beings learn.
- 2) Pedagogical design is a creative process, where the teacher is expected to design instruction for student learning. As in any creative process, it is management of constraints. There are some non-negotiable situations and some negotiable situations. For example in distance learning, the situation is given, and we have to teach the students who are dispersed, and may not be available synchronously. So, the design process has to take this constraint in mind. But, there may be some negotiable situations, as to when the students may be asked to come to a study centre or attend a teleconference or practical session. So, as a designer, you have the creativity to design the learning environment appropriately. Here creativity does not mean to be original, but to use previous knowledge and develop connections in the present context to use the available resources suitably to increase effectiveness. So, pedagogical design is a creative process.

Check Your Progress 3.2

Distance learning is primarily an asynchronous teaching and learning scenario, where the students are separated from the teaching institution. They study at their own place, pace and time. Prepackaged learning materials are supplied to the learners that are designed specially to help them learn individually with minimal support of others. These materials are print-based, but other media are also used. It is in this context that as designer of the pedagogical process that one needs to think about the access and availability of specific technology before we can include that technology in the learning package. With the advent of newer technologies, distance learning is becoming more and more synchronous as virtual conferences are being used to organize classes regularly. The pedagogical design process demands that issues related to access, cost, teaching value, etc of the technology be considered.

Check Your Progress 3.3

- 1) The two basic principles of anchored instruction are:
- Learning and teaching activities should be designed around an “anchor” which is often a story, adventure, or situation that includes a problem or issue to be dealt with that is of interest to the students.
 - Instructional materials should include rich resources that students can explore as they try to decide how to solve a problem (e.g., interactive videodisc programs).
- 2) (a) True (b) False (c) True (d) True.

Check Your Progress 3.4

Column A

Organizational Problems
Project Management
Hazardous situation in a Steel Plant
Topics in Dental Science
Forest and environment in a CD
Teacher Professional Development
Negotiation skills

Column B

Case Study
Learning by Design
Anchored Video Instruction
Problem-based Learning
Discovery Learning
Scenario-based Learning
Collaborative Learning

UNIT 4 MANAGING TECHNOLOGICAL CHANGE

Structure

- 4.0 Introduction
- 4.1 Learning Outcomes
- 4.2 Management of Technology
 - 4.2.1 Decision-making for Use of Technology
 - 4.2.2 Calculating the Costs of Technology
- 4.3 Understanding Management of Change
 - 4.3.1 Need for Change
 - 4.3.2 Nature of Organizations
 - 4.3.3 Importance of Leadership
 - 4.3.4 Vision and Strategic Planning
 - 4.3.5 Why Use Technology?
 - 4.3.6 Factors Affecting Management of Technological Change
- 4.4 Innovation as Change
 - 4.4.1 Diffusion of Innovation
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 - 4.5.1 Copyright in the Digital World
 - 4.5.2 Open Source, Open Content
- 4.6 Let Us Sum Up
- 4.7 Keywords
- 4.8 References and Further Readings
- 4.9 Feedback to Check Your Progress Questions

4.0 INTRODUCTION

One of the biggest problems of technology use in education is its adaptation and integration in the institutional culture and practices. Every time a new technology is introduced, there is some sort of resistance to change due to various reasons. Many do not want to try a new technology, as they are comfortable with the exiting practices, and do not see any value addition. Others think technology as intimidating, and have techno-phobia. However, in distance teaching institutions, use of technology is common and widely prevalent. It is important to manage technology in institutions to effectively deploy appropriate technology for educational activities. In this unit, we will discuss issues related to management of change, innovation and technology costs to help you decide use of appropriate technology for teaching and learning. We will also discuss management of intellectual property in distance learning institutions, including the trend towards use of Open Educational Resources (OER) and Open Source Software (OSS) in education.

4.1 LEARNING OUTCOMES

After working through this unit, you are expected to be able to:

- *Discuss* the process of ‘change’ and the concept of ‘diffusion of innovation’;
- *Analyze* the factors affecting management of technological change;
- *Critically examine* cost and technology issues; and
- *Discuss* management of intellectual property and copyrights within a technology-enabled learning environment.

4.2 MANAGEMENT OF TECHNOLOGY

The word 'technology' comes from two Greek words: *techne* (meaning the skill and craft needed to make something) and *logos* (meaning discussion or knowledge of something). Thus technology means knowledge of how something is made. This is purely the point of view from the production or economics. For technology is both production, and a facilitation too that enables us in educational transactions – in all activities of teaching and learning. Generally, technology is a combination of hardware and software – the hardware being the tangible physical object, and software being the logical process and thinking on which it runs. The adoption and use of technology is an indicator of development of a nation. The developed nations have sophisticated technological power in all spheres of human activity, including education. The ability of the human resources to make use of the technologies, develop and improve these, make the developed nations economically productive and leaders. In this context, the management of technology becomes highly important. Access to technology and its proper deployment to get the most out of it is a human activity. It requires a systematic approach to use technology, and in our context, we are interested in how best educational technologies can be utilized for teaching and learning in institutions. Management of technology is also an issue related to innovation and change. We will discuss about these in this unit. But, let's first discuss about issues related to deciding which technology to use and cost analysis of technology in education.

4.2.1 Decision Making for Use of Technology

Much about use of educational technology in institutions are related to decision-making at the top management level. It is not always a "technical-rational activity", but one which is ruled by prejudice and ignorance. In developing countries, top management's decision on use of a particular technology for teaching and learning may be arbitrary and ad hoc, as technology availability could be due to a government grant or the technology is coming from a donor agency, and the receiving institution can't say no. When institutions do not pay for the use of the technology, it is taken for granted, and never questioned critically about its usefulness in a specific context. For example, the use of satellite time for interactive teleconferencing at IGNOU is free of cost to the University, though there is a cost involved. Thus, there is hardly any serious thinking about its use; and it has been observed that not many students attend these sessions either. Similarly, in 1993/94, the Commonwealth of Learning (COL) provided an audio-conference system to IGNOU that worked with a telephone bridge and could connect to 16 centres simultaneously. After an initial euphoria about its usage for administrative meetings, it has never been put to use in the University. It is therefore, important to critically analyse the usefulness of a technology before it is put to use or purchased. A. W. Bates proposed a framework for deciding the use of technology in open learning. Bates suggests that every institution should take decision on the basis of answers to questions regarding ACTIONS:

- *Access*: How accessible is a particular technology for learners? How flexible is it for a particular target group?
- *Cost*: What is the cost structure of each technology? What is the unit cost per learner?
- *Teaching and learning*: What kinds of learning are needed? What instructional approaches will best meet these needs? What is the best technology for supporting this teaching and learning?

- *Interactivity and user-friendliness:* What kind of interaction does this technology enable? How easy is it to use?
- *Organisational issues:* What are the organisational requirements, and the barriers to be removed, before this technology can be used successfully? What changes in organisation need to be made?
- *Novelty:* How new is this technology?
- *Speed:* How quickly can courses be mounted with this technology? How quickly can materials be changed?

Access: A distance learner may learn at home or at work place or at a local centre. How much technology is available to a learner will depend where he/she is placed at the study time. Open access, home based learning will be limited in many countries to relatively few technologies. For example, the poorest countries may be in a position to use only print and radio, while slightly wealthier countries may use print, radio, audio cassettes and possibly television. The developed countries will use all these and the telephone, the computer and so on.

Availability is only the tip of the iceberg though. Even in the wealthiest countries, there is always a section of people who do not own a television or even access to a telephone. Is the use of a technology to be denied to those who have access to it, so as not to discriminate against those who do not?

Cost: A number of general points can be made about the balance of costs for different technologies. The cost of putting equipment into local centres can far exceed capital costs $\frac{3}{4}$ for example, for organizations with multiple study centres. The major cost of using technologies for teaching is in production rather than capital and hence it is recurrent for instance, the yearly recurrent cost often exceeds the total start-capital cost: in general, the recurrent costs of producing good quality technology-based materials tend to be underestimated.

Technologies vary considerably in their fixed and variable costs:

- Audio cassettes and radio have low fixed and low variable costs;
- Face-to-face teaching, computer-mediated communication and tutor-mediate tele-courses have low fixed costs but high variable costs;
- Pre-programmed computer-based learning (CBL) and video discs have both high fixed and high variable costs, if work-stations are to be provided;
- Since production is the main cost, and hence fixed for any course, for most technologies currently used in national distance teaching and open learning institutions fixed costs usually far exceed variable costs; this means that the economies of scale apply to 'traditional' distance education courses: the more students, the more cost effective technologies become;
- Some of the newer interactive technologies, such as computer conferencing and audio-graphics, reduce fixed costs, but have high variable costs; thus, while suitable for sources with relatively low student numbers they will be very expensive for courses with large student numbers;
- Broadcast distribution is likely to be uneconomical for national distribution with less than 500 students per course for television, or less than 1,000 students per course for radio; satellite distribution may be economically viable on a regional or sub-continental basis, if the production costs can be justified in terms of the likely target audience;

- Audio cassettes are a particularly economical medium; audio cassettes plus, for example audio vision is usually a cheaper combination than the cheapest form of video or computer-based learning.

It can be seen that the likely size of a course, in terms of student numbers, is crucial in influencing the choice of technology.

Teaching functions: You might feel that teaching functions should be the first criterion to be considered. After all if the technology is not effective, as a teaching tool there may not be much point in using it. However, it is much easier to discriminate between media on the basis of access or cost than on that of teaching effectiveness. The bases of media are flexible. Each medium can be used in a wide variety of ways. Consequently, difference within a medium (for example, a televised lecture and a documentary) may be greater than between media (for example, a face-to-face lecture and a lecture on a radio programme).

The choice of media depends on their presentational qualities and ability to develop skills. The presentational qualities of each medium can be exploited by the course designer in relation to the course objectives and what kinds of learning (comprehension analysis, application, problem-solving, inter-personal, mechanical skills, attitude change, etc.) are required.

Interactivity and user-friendliness: The extent to which a particular medium encourages interaction and active learning, and its user-friendliness is of utmost importance. Some technologies provide 'real-time' interactivity, whereas others are only asynchronous. Some are one-way interactive media, while others are two-way interactive. Since, the learner in distance education is at a distance from the teacher, the interactivity of the medium is of paramount importance. As far as the question of user-friendliness is concerned, it is the quality of the medium to provide control to the learner. For example, in a TV broadcast, the message just passes away and you can't go back to a specific frame. But in a video tape, you can just fast forward and rewind to understand a specific concept as many times as you want.

Organisational issues: The issues related to organisation deal with how to exploit the potential of each medium. The organisation must be ready to change and/or adopt new technologies relevant to its operation. Since technologies require additional cost, the organisation would like to effectively deploy both manpower and technologies to adopt changes. At the time of taking a decision regarding technology, issues like how much training the staff would require to handle it need to be assessed. May be depending on the requirement, the overall organisational structure, job roles, etc. may need re-engineering.

Novelty: Bates recommends that novelty should be the least important of all the criteria. However, at times the novelty of the medium attracts funding from different agencies. But, you must be sure about the pedagogic utility of the medium before being fascinated by its novelty. And if the medium is not cost-effective, it will ultimately be a burden on the institution.

Speed: It relates to how quickly the medium allows the institution to make the shift to the new medium. Some technologies take more time for development. For example multi-media learning packages take more time. Even video tape takes lot of time to produce their audiotape. Also you must consider the speed at which the materials can be updated and revised.

Table 4.1 presents the comparative strengths of different media and technology analysed by Bates (1995). However, it may also be noted here that such categorization is only indicative, and if you are asked to decide on a technology in your institution, it is better to critically analyse the points covered under ACTIONS.

Table 4.1: Strengths and Weaknesses of Various Technologies

Media	Access	Costs/Students Nos.		Teaching		Interactivity		Organi- sation	Speed
		Large	Small	Presen- tation	Skills	Learning	Social Material		
One-way Media									
Print	Good	Good	Average	Average	Average	Average	Poor	Poor	Poor
Radio	Good	Good	Poor	Poor	Poor	Poor	Poor	Average	Good
Audio Cassette	Good	Good	Average	Average	Good	Good	Poor	Good	Average
Educational Broadcast TV	Average	Poor	Poor	Good	Average	Poor	Poor	Poor	Poor
Pre- recorded TV	Poor	Good	Poor	Average	Average	Average	Average	Average	Poor
Video cassettes	Good	Average	Poor	Good	Good	Good	Poor	Average	Poor
Computer based learning	Average	Poor	Poor	Average	Average	Good	Poor	Poor	Poor
Multimedia	Poor	Poor	Poor	Good	Good	Good	Poor	Poor	Poor
Two-way Media									
Audio Confe- rencing	Good	Poor	Good	Poor	Average	Poor	Good	Good	Good
Live Interactive TV	Poor	Poor	Poor	Poor	Poor	Poor	Average	Average	Good
Video Confe- rencing	Poor	Poor	Average	Poor	Average	Average	Average	Average	Good
CMC	Average	Average	Good	Poor	Good	Average	Good	Good	Good

(Source: Bates, 1995)

4.2.2 Calculating the Costs of Technology

One of the major issues related to deciding the use of technology for teaching and learning pertains to the costs of technology – costs to the institution and costs to the learners. Technology costs lots of money for the institutions, and it has a variety of associated costs. It is important to analyze these to understand the cost structure of using a particular technology. While my objective here is not to have a full discussion on cost and economics of technology, I would like you to understand the categories of costs associated with analyzing technology costs in teaching and learning contexts. We take for granted the availability of electricity and other infrastructure in office, and therefore tend not to consider these as costs involved. Some also believe that costing educational activity is not possible, especially cost-benefit

analysis. While benefits are not always tangible and visible, cost analysis is done with certain assumptions that are open to challenge. For example, your institution may decide that 'overhead charges' would not be included in cost analysis of new technology. This would have significant influence in the total cost calculations. So, the assumptions are context-driven.

In order to calculate the cost of technology application in education, you must differentiate between *fixed* and *variable* costs. Fixed costs do not change with increase or decrease in number of learners, while variable costs do. For example, the development costs of a video programme or Multimedia CD is fixed, while its distribution cost to the learners would increase with the increase in the number of learners. Research shows that cost increases with the increase in number of learners in classroom teaching. In comparison, the use of printed learning materials or multimedia materials significantly reduces the total costs. The use of computer mediated communications (CMC) such as discussion groups and virtual conferences increases the total costs and are usually higher than only use of multimedia materials, and less than classroom teaching. But, if you want to use both CMC and multimedia materials/ Web-based materials, it may not be cost-effective for smaller number of learners. This is so because, use of CMC require teacher interventions (though not at the same level of classroom teaching), and the initial costs of development of multimedia materials are higher.

To calculate the costs, it is important to record every detail of the expenditure accurately and faithfully. Bates (2000) says "costing is like playing golf. If you cheat, it is between you and God – no one else is likely to know!" Many a times, the overhead costs (capital costs and operating costs) are difficult to ascertain, and especially amortization of the capital costs is only a guesstimate/assumption. In Table 4.2 we present the cost heads of a web-based course that uses multimedia-web based materials, readings from journal articles (require copyrights payments), etc. In order to estimate the cost per learners, it is also important to analyze the costs over the *life of the course* (which may be 3-5 years).

From Table 4.2, you may note that the costs of a programme/course would depend on the core instructional design and teaching and learning model it follows. While development of multimedia materials would add to high cost, by using set books as an alternate model you can pass on the cost to the learner. For tutoring, the number of tutors would depend on the number of learners. A tutor may moderate a group of 15-20 learners in a course, and thus, a course having 100 learners would require at least 5 tutors, and thus the cost would be more. You can also design courses that may not have more interaction at the learner-learner or learner-tutor level, and the online content can take care of the interactivity component. In such a situation the variable cost can be reduced. Cost of technology-based courses depends on how technology has been planned to be used. It may also be noted that in online courses, the learners spend extra money in addition to the tuition fees. These costs for learners are in purchase of computer/laptop and relevant software, and the Internet access time.

Table 4.2: Item-wise Cost Headings

Items (All items to be covered)	Costs in Rupees/Dollars					
	Year 1	Year 2	Year 3	Year 4	Year 5	Total Costs
Fixed Costs (Capital)						
- Subject Experts						
- Web Developers						
- Multimedia Developers						
- Instructional Designers						
- Copyright						
Sub-Total						
Fixed Costs (Operating)						
- Institutional Overheads						
- Departmental Overheads						
- Server changes (LMS hosting, web space, bandwidth)						
- Quality Assurance Approval						
Total Fixed Costs						
Variable Costs						
- Tutoring						
- Delivery Costs (Registration, ID Cards, etc.)						
Total Variable Costs						
Total Costs						

Check Your Progress 4.1

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

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

1) Expand and explain the acronym ACTIONS.

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2) List the item-wise cost headings for an online programme.

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4.3 UNDERSTANDING MANAGEMENT OF CHANGE

Change is something that is inevitable. It happens all the time. But, it is perhaps one of the most difficult issues to handle in organizations. Understanding change and taking appropriate action differentiate between successful and unsuccessful organizations. Organizations that can predict and manage change effectively survive in difficult times. Change in organizations happen due to many reasons: change in purpose, organizational structure, technology, people, etc. Changes may also be external to the organization such as changes in the lifestyle of the clients. For example access to mobile phone amongst learners is a significant change that educational institutions may take note for their future planning activities. Some changes may be planned, while others may be sudden and unplanned. It is therefore important to manage the change process systematically, especially when the change is due to induction of a new technology. The purpose of change management is to facilitate organization's integration into and adaptation to the new changed environment. Shoham and Perry (2009) present five models of change management:

- **Dynamic Stability Model:** The model strives to move the organization from a state of instability to a state of stability by unfreezing, changing, and refreezing. Change In this model is a transient stage.
- **Problem Solving Model:** In this model change happens due to a problem, and organization's desire to overcome the same.
- **Strategic Planning Model:** This model has three stages: dissatisfaction, vision and step towards change. It is a systematic approach that the top management takes into consideration when they are dissatisfied with the existing situation.
- **Eight Stage Model:** It was proposed by Kotter (1998) that includes a sense of urgency, creating a guiding coalition, developing a vision and strategy, clarifying the change and vision, empowering broad-based action, generating short-term success, evaluating change and anchoring new approaches in the organizations culture.
- **Dynamic Systems Model:** This model believes in transformative systems, where people and processes interact to being transformation through discussion and dialogue. It is based on systems theory, and therefore, the components are interdependent, inter-related and function in a synergetic manner to provide feedback in the change process.

While these models are drawn from the corporate world, educational institutions are different in their objectives, functions and organization. Being mostly not-for-profit and following a 'collegial decision-making' model, they are difficult to change, especially when it comes to pedagogical practices. However, Scott (2003) lists the following four forces of change faced by higher education intuitions:

- Increase competition of educational providers from within and outside the country;
- Decrease in governmental funding in education;
- Mounting trend towards consumer rights as education is considered as a service leading to students not hesitating to take educational institutions to court for poor service; and
- Influence of information and communication technology in all walks of life, and availability of information on the Internet.

4.3.1 Need for Change

Is there a need for change in your institution? I am sure your answer would be a big 'yes'. We are not always happy with what is happening around us. But, if you are asked to change, we may not be too enthusiastic, as change is something that we all are afraid of. We do not want to come out of our comfort zone, and do not want to tread the path of unknown. But, as part of distance education institution, it is no more possible to continue with the age old practices. The support from the government for all types of educational institutions is decreasing, and distance education is no exception. Moreover, there is a perception that distance education institutions can sustain themselves. Thus, there is a need to do 'more with less', and every dollar spent has to be justified by reaching more learners with quality education. It is no more possible to run universities with traditional graduate programmes alone. The skills and knowledge needed by the employers in the 21st Century are different, and therefore educational provisions in distance education institutions must cater to societal needs by modifying/ revising courses and programmes and innovating new ones that meet the needs of the workforce.

4.3.2 Nature of Organizations

Distance education institutions are primarily 'Fordist' in their nature. That they believe in industrialization of the education as pronounced by Otto Peters. The features of industrialization that are found in distance education are:

- Production of uniform products as self-learning materials
- Economies of scale due to large number of enrollment for courses
- Division of labour in production of learning materials, and also in delivery of teaching and learning, as teaching is done through self-learning materials and tutoring
- Hierarchical management due to departmentalization of activities
- Standard, bureaucratic policies and procedures for operation of different activities
- Automation of processes and activities

In contrast, the face-to-face teaching follows an agrarian organizational model, where the teacher prepares the curriculum, identifies the resources, teaches in the classroom, does the student evaluation, etc. as a farmer does all activities in agrarian society. So, distance education institutes are different, and operate in the Fordist model. But with the advent of information technology, there is a new model that is emerging, which is called as the post-Fordist or post-industrial universities. Such universities depend heavily on information technology; are networked; operate through different locations; employees also operate in a decentralized manner; are characterized by strong visionary leadership ready to take on new opportunities and challenges. These institutions operate globally and develop their *brand image*. Examples include University of Phoenix, Western Governors' University, Jones International University, etc. Following this model, open universities and distance education institutions are also changing to adopt the practices of post-Fordist institutions and creating online learning centres and virtual learning centres.

4.3.3 Importance of Leadership

To see the change institutionalize, it is important to have a strong leadership. Usually the Vice Chancellor/President is the main force behind change in many universities. However, we also know that this does not happen just be one person. There is always need for other people in the senior management who shares the vision and thinking of the leader to make change happen. So, in this context, a good leader is one who can find competent people within the institution who buy-in his vision, and propagate the same in all ranks. In this sense, leadership is not something to be only found in the Vice Chancellor, but leadership as a quality is required amongst all workers who are be part of the change process. A team based leadership works very well in post-Fordist organizations, and the leadership should focus on the following:

- Define a vision of teaching and learning through technology
- Identify new target groups that can be reached through technology
- Define priority areas and target groups for appropriate programmes
- Identify areas and strategies to populate information technology related activities within the institution
- Identify the needs for capacity building (including human resources) for application of information technology
- Promote and reward innovation and appropriate use of technology
- Develop strategy for key technology procurement and implementation

For all these to happen, the role of leadership is to recruit competent people. In this context Bates (2000) says leadership is more about *quality* than *strategy*. He says “It is really the responsibility of the board of governors and the president, or deans, through their appointment process, to ensure that senior managers or heads of department have leadership quality and an understanding of the strategic importance of applying new technologies to teaching and learning.” Understanding of new technology applications in distance education by leaders would go a long way in the change management process.

4.3.4 Vision and Strategic Planning

Vision is the art of seeing the invisible.

– Jonathan Swift

It is the role of the leadership to develop a vision and strategic plan for use of technology in teaching and learning in the institution. Developing an institutional vision is a complex process; though you may have a personal vision for technology use. Vision is not same as that of mission. While mission defines the fundamental purpose of the organization, vision is the intended future state of the organization. The vision statement outlines what the organization would like to be in a future date. In the context of technology, it is a document that clearly shows the path of adopting technology in teaching and learning. Fritz (1989) defines vision as a set of concrete scenarios that reflect exactly what we would like to be doing in the future. While the vision statement can be just a sentence or a paragraph, the vision document will also include the strategy to achieve the vision.

Strategic planning, therefore, considers:

- What do we do?
- For whom do we do it?
- How do we excel?

The strategic plan for use of technology in teaching and learning should cover a long term view and include situation analysis, goals, and specific action that can be implemented. Though strategic planning is an institution wide activity, it is important to have departmental strategic plans which are consolidated to prepare the institutional plan. The strategic plan helps us to do monitoring of our progress, and we know when the vision is realized leading to institutionalization of change. When strategic plans are discussed in the institutions, everyone knows the expected outcomes and work towards that. But, if the plans are not shared or changed without consultation, the result may not be as expected. Some also believe that strategic planning is a long term activity, and it is not possible to apply the same in organizations that depend more on information and communication technology that moves very fast. In spite of such criticism, in order to implement change we need to have a roadmap, and strategic planning is a process to develop that roadmap.

4.3.5 Why Use Technology?

In the change management process, technology is vital. When it comes to distance education institutions, technology is central to many of its operations. When technology changes, it is natural that existing practices would change. Therefore, it is not necessary here to convince you of the reasons of using technology for change. However, let's state the reasons for use of technology for emphasizing the need for technology for management of change process.

Reasons for using technology in distance education institutions are:

- To improve the quality of teaching and learning by adding suitable technology that increases the amount of interaction between student and a teacher and student and student
- To provide learners with suitable technology literacy for work and life
- To improve access to quality education and training using online and mobile learning platforms
- To reduce the cost of education (this is a debatable statement)
- To improve the cost-effectiveness of education
- To meet the technological imperative

Use of technology for teaching and learning in distance teaching institution is common. But, it requires constant vigilant to remain up-to-date to be a leader. Technological imperative demands that when a suitable technology is there, and it is not used by an institution, others look it as sign of backwardness. While this interpretation may be too extreme, and we do not promote mindless use of technology, it is useful to be evaluative in deciding the use of technology for change.

4.3.6 Factors Affecting Management of Technological Change

Having discussed some of the issues in change management in the preceding sub-sections, now let's turn to discuss factors affecting management of technological change. It has been discussed so far that leadership is an important factor, and having a clear vision and strategic planning for implementation of the technology makes the change process hurdle free leading to a stable organization. In the context of distance education institutions, we also know that application of technology in teaching and learning moves the Fordist organization to a post-Fordist

model that has characteristics of both agrarian and Fordist model. In such a scenario, let's identify some other factors that we must take care of during implementation of change. These are:

- Role of change agent: Having champions of change or change agents in the organization who play the role of catalysis in the process is very important. Such people can be trainers and staff developers, who provide the necessary training to adapt change.
- Finance: Appropriate funding of the technology implementation is a must to see the change. Without sufficient budgetary provisions technological change may be incomplete as technology needs heavy investments initially.
- Opposition to change: Addressing opposition to change through improved communication helps in effective change management. Most opposition to technology is due to negative perceptions about it. Regular training programmes, newsletters, etc. about the use and effectiveness of the technology adds to removing fear amongst the stakeholders.
- Eliciting cooperation: Change is a slow process in academic institutions, and therefore it is important to elicit cooperation from all stakeholders. It is also necessary that everyone is sympathetic towards the change and remain patient when the newly created system does not work as expected. Providing feedback to improve the system is part of the change process and to stabilize the change, we must elicit feedback and cooperation.

Check Your Progress 4.2

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

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

- 1) Identify the major factors affecting management of technological change in an organization.

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- 2) Explain the meaning of strategic planning in the context of technology in education in about 100 words.

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Now let's see change as innovation or innovation as change!

4.4 INNOVATION AS CHANGE

Innovation has become a buzz word in all walks of life, and Distance Education is not far from it. The Asian Association Open Universities (AAOU) Conference in Teheran in 1995 was first such occasion to devote full fledged discussion on innovations in distance learning. But, if we closely look at the deliberations there and elsewhere in distance education literature about what is innovation, it would be much clear that there is much to be desired. While some would consider the use of an existing technology in a new context as innovation, others would consider a new teaching learning programme an innovation. Broadly, innovation is the act of starting something new. It could be a new *idea*, a new *product* or a new *process*. Two important concepts are related to innovations – creativity and change. Innovation is a creative process, and it advocates change in the current practice. The change could be radical or incremental. However, it is different from invention. Innovation is idea applied in practice. As such, distance education itself is an innovation in the field of education!

We can all be creative and innovative, but contrary to popular belief innovations are not always appreciated. Remember, Alexander Graham Bell, who invented telephone was turned down by Western Union telling it as a “useless toy”. Scott Berkun, author of the *Myths of Innovation*, states “Every great idea in history has the fat red stamp of rejection on its face”. Does that mean, we should stop thinking and innovating? No. The real innovators sustain and persist. There may be rejection due to ego, pride, politics, priority, fear, greed, etc, but innovators survive due to their convictions and belief in what they have strived to create. Fortunately, history shows that when institutions do not recognize innovations, it results in entrepreneurship. But, this is also a sign of institutional failure to accept innovations internally, experiment and institutionalize ideas, because it may come from a person in low hierarchy. Fortunately for distance education in India, and for the Indira Gandhi National Open University, we have the National Centre or Innovations in Distance Education (NICDE), which has various schemes for recognizing innovations within the institution and the system in the country.

For distance education innovations is an imperative. It is not something that we may do, but it is something that we must do. For example, cost-effectiveness is one of the strong pillars of distance education. If we do not constantly think and innovate how can we maintain cost-effectiveness? One programme may not be cost-effective, but the system as a whole should be cost effective to justify its existence as an alternative mode to provide quality educational access to large number of people. So, we need to innovate new programmes that cater to the needs of the market. We need to use new instructional and learning design principles to develop programmes that are suitable to the needs of the learners. We need to use appropriate technology to make the programme more interactive and useful to the learners. In all the activities, we need to think about the philosophy of open learning and innovate appropriate distance education programmes that provide access to more people at less cost. Innovations in distance education therefore should follow a system-wide perspective, and it is the responsibility of teachers and administrators to think about the system as a whole. Innovations are required in the areas of curriculum design, instructional design, learning material preparation, ICT enabled programme delivery, new programmes, and new technologies in education.

4.4.1 Diffusion of Innovation

Diffusion research comes from many disciplines, but emphasize on one thing: the speed of spread of the innovation within an organization or society. There is a set pattern in the process of diffusion that has been observed. An innovation to get diffused in an organization or society follows a five stage process: Knowledge or awareness about the innovation, a stage of persuasion and explaining the advantages, decision by the stakeholders (acceptance/rejection), implementation (if accepted), and confirmation or continuance with the innovation. The speed of adoption of a technology in the society differs greatly, and to reach a critical mass of adoption it take time. Table 4.3 shows some technologies and the speed of change acceptance in the society.

Table 4.3: Speed of Introducing Technological Development into Social Use

Specific Technology	Invention	Innovation	Speed of Change
Aspirin	1853	1899	46
Incandescent Lamp	1854	1880	26
Telephone	1860	1887	27
Photography	1871	1888	17
Synthetic Rubber	1882	1932	50
Ballpoint Pen	1888	1938	50
Fluorescent Lamp	1896	1938	42
AM Radio	1900	1920	20
FM Radio	1902	1936	34
Aeroplane	1903	1920	17
Vacuum Tube	1904	1915	11
Helicopter	1907	1938	31
Black & White Television	1907	1936	29
Colour Photography	1912	1935	23
Colour Television	1925	1953	28
Nylon	1927	1938	11
Penicillin	1929	1942	13
Jet Aircraft	1930	1942	12
Polaroid Photo	1937	1948	11
Xerography	1937	1950	13
Electronic Computer	1945	1951	6
Transistor	1947	1951	4

Source: Sharif (1983).

Everett Rogers (1962) in his book *Diffusion of Innovations* categorized individuals as adopters of innovation at different level within an organization or society. According to him there are five types of adopters: innovators, early adopters, early majority, late majority, and laggards. The number of people in each category if plotted in a graph follows the S-curve or bell curve pattern (see Fig. 4.1). The innovators (2.5%) are those who actually start the innovation or first adopt it. They are risk takers, and greatest contact to scientific sources and interactions with other innovators. The early adopters (13.5%) are opinion leaders and adapt to an innovation in second fastest way. They are typically younger people in an organization with advanced education and are forward looking. The early majority (34%)

take significantly more time to accept an innovation than innovators and early adopters. They are influenced by the early adopters, while the later majority (34%) is those who approach an innovation with lots of skepticism and adopt to change after a long checking and verification process. The laggards (16%) are those who are the most difficult to handle in the change process. They believe in tradition, and are mostly unwilling to change. It is this group that may also create possible hurdle in implementation of an innovation to change existing practices. They do adopt to change the last in an organization. So, while implementing change in an organization, it is important to pay attention to the different types of adopters, identify them and address their concerns accordingly.

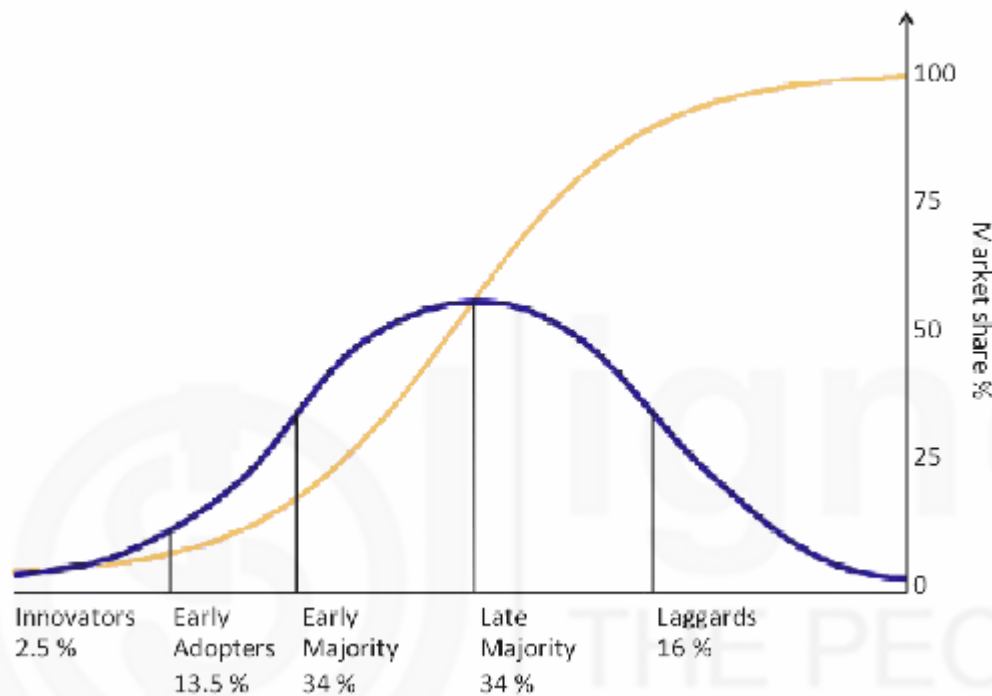


Fig. 4.1: Bell curve for adopters of innovation (Source: Wikipedia)

4.5 MANAGING INTELLECTUAL PROPERTY

Intellectual property has emerged as a major issue in distance education, especially due to the use of digital media and resources in the delivery of education. While intellectual property covers a broad range of concepts such as patents, copyrights, trademarks and designs, in this section we will focus only on copyrights. The copyright laws differ from country to country, though there is a general convention on it to which most countries are signatory. Thus, we will make general statements on copyrights related issues, and would suggest you to consult your legal advisor, when in doubt. There are certain aspects of the copyrights law that are subject to interpretations and sufficient cases are not available to make generalizations. Many a time copyright violations are not even reported as the compensations may not justify the litigation costs and it also takes time to get judicial verdict as legal case can go from lower courts to upper courts till the supreme court of a country, and thus wasting time and resources. For educational institutions that create contents, this is a problem as they need to protect the intellectual property created by their faculty, and provide appropriate rewards to the creators. While we are not going to take discuss how to safe guard intellectual property, we are more interested in how not to violate the laws and avoid legal battles. Distance education intuitions

develop huge amount of contents like major publishers using large number of authors, and therefore, it is important that copyright policies are in place to safeguard institutional interests.

Copyright is the exclusive rights given to the creator of the original work to reproduce, translate, adapt, copy, perform, authorize, receive royalty and engage in any other economic benefits arising out of the work. The Copyright Act, 1957 (in India) protects the creator of the original work by making it illegal for others to use the original material without the creator's or owner's consent. Many distance teaching institutions appoint Copyright Officer to handle issues related to copyright, asking for permissions, payments to copyright holders and keeping records of copyright permissions granted by the institution. Some other institutions advise the authors to get the copyright permission if third party materials are used beyond "fair use" or "fair dealing" clause. The fair use clause in copyright laws allows for a small proportion of work to be used without the need to seek permission from the copyright holder. However, the amount of "small" is open to interpretation. Moreover, it is also possible to use some works (one time only) in the classroom contexts, and that would not be violation of copyrights. But, in distance education contexts the issue of fair use become complex. As the materials are printed, and many institutions do earn profits out of the works!

4.5.1 Copyright in the Digital World

The issue of copyright become more complex in the digital world. Many believe that the mere access to a website without password protection is free availability of the same to be used by anyone in their work. In fact, a website is like a book. So, the copyright laws are also applicable to the websites, and unless and otherwise the author/creator of the website give open permission to use the content, we can't make use of the same in our work. However, fair use for the purpose of research and criticism are always permitted. Some also think that the websites are in public domain! In fact, it is not. The phrase 'Public domain' connotes that any material that are not covered by copyright laws or the intellectual property rights have expired. For example the copyright expiration in many countries ranges from 50-70 years after the death of the creator. In United States the Government works are not covered under copyright and are available in public domain.

Who owns online courses and digital materials? This is a question often asked by many, especially in the context of online learning. The materials created under hire (job) are normally owned by the employer. So, the learning materials created by a teacher under employment are the copyright of the employer. However, this is governed by the contract of the teacher in many universities. Some universities allow the teachers to use the materials in their own works. Some even permit the teachers to take the course with them when they leave the university. So, institutions must have clarity on copyrights of the work created by them, especially those created by the staff and those created by outside consultants. Whatever may be the situation, while creating copyrighted work, it is important that use of works of others as per accepted conventions, and permissions are taken from the copyright holder for tables, graphics and when a significant portion of text is used.

Bates (2000) provides the following advice on copyright for creators of digital materials:

- Use the same rules of print publication to digital materials, wherever possible.

- When in doubt, ask for permission. Usually permission is granted by the creator for non-for-profit use.
- Always password protect your course sites, and also inform the users that the materials in the site are for their personal use, and not for sharing with others.
- Provide links to other sites, rather than copy materials and host in your server.
- While using links to other sites, check the copyright provisions in the site. If advised, inform the webmasters. Sometimes due to heavy traffic on a site it may crash (if appropriate bandwidth is not available), and thus it is morally your responsibility to inform the sites, if you are directing large number of users to them.
- Clearly give copyright statement in your sites and multimedia materials.
- Always acknowledge the use of other materials, especially indicate the permission taken.
- Do not give permission to use third party materials in your site. Refer the requesting person to the appropriate copyright holder.
- Educate all stakeholders about copyright and its implications.
- Develop appropriate legal instruments, contracts, agreements following the copyright laws.

4.5.2 Open Source, Open Content

In response to the complexities of the copyright regime, the open source movement has emerged in 1985 with the establishment of the Free Software Foundation (FSF) (<http://www.gnu.org/>) by Richard M. Stallman. The FSF has developed the General Public License (GPL) that is often called “copyleft” to allow programmers to release the software with its source code. In the year 1991, Linus Torvalds, a student at Helsinki University started a project that would spread to become the “poster child of open source” (Hart, 2003). With the release of version 0.1 of the Linux kernel as an operating system, open source as an alternative approach to software development became popular. In the mid-1990s, Netscape decided to publicize the source code of its browser, which led to the emergence of the Open Source Initiative (OSI) (<http://www.opensource.org/>) as an alternate institution to FSF. The OSI maintains that for any software to satisfy as open source,

- the source code must be distributed with the software or otherwise made available for no more than the cost of distribution;
- the software be allowed for re-distribution without any royalty payment to the creator; and
- the user can modify the source code and then distribute the modified software under the same terms.

Sometimes, the software released under open source is also called “Free and Open Source Software” (FOSS). To a certain degree, open source software is free of charge to the extent that they do not charge licensing fee for usage. However, it should not be confused as “freeware” that are made available free of cost in their executable form without the source code. In the case of open source, the *free* is as in *freedom*, and can be seen as:

- freedom to access the source code;
- freedom to use the software without paying any license fee;
- freedom to re-distribute; and
- freedom to modify the software and distribute.

Open source software is becoming popular in education due to the cost advantage. The software is free, and thus no payments are to be made. However, some service providers may take training and maintenance charges. Today, almost all proprietary software has an open source alternative that you can find on the net. Following the open source movement, in 2002 with the initiative of the UNESCO, the open content movement started which is now popularly known as Open Educational Resources (OER).

OER has been defined as “the provision of educational resources, enabled by information and communication technologies, for consultation, use and adaptation by a community of users for non-commercial purposes” (UNESCO, 2002). So, open content materials follow an open licence policy thereby permitting other users to use the work without permission. The emergence of Creative Commons licenses for OER has made it easier for creators of original work to specify the terms and conditions of use. Using OER materials, institutions can save money and avoid duplication of work. The UNESCO has developed a website for the promotion of OER (see <http://oerwiki.iiep-unesco.org/>). There are many other such provisions with huge contents suitable for learners from kindergarten to lifelong learning available. Some of these are:

- WikiEducator (www.wikieducator.org)
- Connections (www.cnx.org)
- Curriki (www.curriki.org)
- OER Commons (www.oercommons.org)

You can search for more such sites on the web.

Check Your Progress 4.3

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

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

1) What is innovation? Explain in about 150 words.

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2) Explain the five types of technology adopters in any organization.

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3) Choose the right answer.

- i) Copyright of a work available online:
 - a) Does not exist because the Internet is part of public domain.
 - b) Is same as the copyright of the work, if published in print.
 - c) Depends on whether a copyright notice is available or not.
 - d) Last for the life of the author plus 14 years.
- ii) If a work is in the public domain, it means:
 - a) The work is available online.
 - b) The work is available in a public library.
 - c) The work can be copied without permission.
 - d) The work is copyrighted by the society.
- iii) Fair use/dealing means:
 - a) The right to copy entire work without taking permission.
 - b) The right of teachers and students to use copyrighted work without permission.
 - c) The right to use material available on the Internet
 - d) The right to use reason portion of a work for research, review and criticism.

4.6 LET US SUM UP

Management is systematic activity. Without scientific management, it is not possible for organizations to be managed to achieve their goals. So, institutions do have structures, policies and procedures to work and achieve the organizational goals and excellence. Educational institutions, especially distance teaching institutions, are established to provide education and training to people, and provide wider access to education. Use of technology in education has become common, and in distance education inevitable, as it is primarily a technology-mediated system of education. Appropriate use of technology within the institution is significant in the process. In this unit, we highlighted the significance of management of technology with special reference to choice of appropriate technology and calculation of cost of technology. We discussed the ACTIONS framework of Bates in this connection that emphasize the need to understand students' access to technology, cost of the technology, teaching functions performed by the technology, interactivity offered by the technology, organizational issues associated with the technology, novelty value and speed of the technology for change.

We also discussed the factors affecting management of change, and emphasized the role of nature of organization, leadership, strategic planning, and need of change and rationale for appropriate technology. We discussed about innovation as change, and how innovations diffuse within organization. We identified five types of adopters to change, and discussed how to motivate these individuals to accept change. In this unit we also discussed about intellectual property rights related issues such as how to follow the laws related to copyrights. We discussed about the emerging trends in open educational resources and open license arrangements about content utilization in the digital world.

4.7 KEYWORDS

Change Management: is the process of structuring and controlling the change in an organization.

Copyright: is the exclusive rights given to the creator or author of an original work to copy, distribute and adapt the work. It can be assigned to another person who is not the author, and the copyright holder can license the work for payment.

Innovation: is a change in the thought process of doing something. Innovation can be a new idea, a new product or a new process. But, it is not necessarily a new invention. It could be a new application of an already invented item.

Open Source: relates to availability of the source code of a software program, and its related freedom to distribute the work and its derivative freely to others.

Strategic Planning: is the process of preparing strategic plan in an organization. This will include situation analysis, identification of strengths and weaknesses, development of a roadmap, clarifying the objectives, and deliverables with timeline to monitor progress and evaluate the implementation of the strategic plan. The end product of strategic planning is a plan document.

4.8 REFERENCES AND FURTHER READINGS

- Bate, A.W. (1995). *Technology, Open Learning, and Distance Education*, New York: Routledge.
- Bates, A.W. (2000). *Managing Technological Change*, San Francisco: Jossey-Bass.
- Fritz, R. (1989). *The Path of Least Resistance*, New York: Columbine.
- Kotter, J.P. (1998). Winning at change, *Leader to Leader*, 10, 27-33.
- Rogers, E. M. (1962). *Diffusion of Innovations*, Glencoe: Free Press.
- Scott, G. (2003). Effective change management in higher education, *Educause Review*, 38, 64-80.
- Sharif, Nawaz (1983). *Management of Technology Transfer and Development*, APCTT, Bangalore, p. 28
- Shoham, S. and Perry, M. (2009). Knowledge management as a mechanism for technological and organizational change management in Israeli universities, *Higher Education*, 57, 227-246.
- UNESCO (2002). *Open and Distance Learning. Trends, Policy and Strategy Considerations*. Paris, UNESCO.

4.9 FEEDBACK TO CHECK YOUR PROGRESS QUESTIONS

Check Your Progress 4.1

- 1) ACTIONS stands for Access, Cost, Teaching function, Interactivity, Organizational issues, Novelty and Speed. A. W Bates has developed ACTIONS as a framework to choose appropriate technology for teaching and learning in an institution. It provides a rational basis for educators to think about access of a technology to the students; its cost to institution and students; teaching functions it can deliver; nature and levels of interactivity; newness of the technology to motivate the user; and speed of change of technology so as not to affect the cost structures drastically.
- 2) Costing of online programmes requires us to identify the items under fixed and variable costs. The fixed costs (also called capital cost) of a programme includes the programme development cost such as the payments made to the subject matter experts, web and multimedia developers, instructional designers, and

copyright costs of media elements. There are another category of fixed costs (that can be attributed as operating costs): such as the institutional overheads, departmental overheads, server charges, and quality assurance approval related payments. Besides these, the variable costs include cost of tutoring, delivery cost of CDs, Identity Cards, etc. to the students. To calculate the cost of the online programmes, it is important to calculate the cost of each and every item carefully.

Check Your Progress 4.2

- 1) Factors affecting management of technology includes, but not limited to the following:
 - A clear understanding for need to change
 - Understanding of why to use a particular technology
 - Knowledge of the nature of the organization (Fordist, post Fordist)
 - How the leadership is disposed to technology, and how it promotes the same in the institution
 - Whether the institution has a strategic plan for implementation of technological change
 - Availability of champions of technology to take the role of change agents
 - Capacity building activities to train the staff to use technology
 - Availability of adequate fund to implement the change
 - Cooperation of all the stakeholders
- 2) Strategic planning in the context of educational technology in an institution is the blueprint to use technology for teaching and learning. The strategic plan should consist of what to do, how to do and for whom to do. It should include a situational analysis, strengths and weaknesses of the institution; provide specific goals to be achieved after implementation of the strategic plan; and the achievable targets and milestones. The plan is used for monitoring the progress of implementation, and also for evaluation of the implementation in the light of the strategic objectives and their achievements.

Check Your Progress 4.3

- 1) Innovation is the act of starting something new. It may be an idea, a product, or a new process. Innovation is a creative process and it expects change in the organization. In the context of distance education, constant innovation is important to maintain cost-effectiveness of the system as a whole. Innovation is not invention, and therefore, a new use of an already existing technology can also be considered innovation. For example, using email to provide training can be considered innovative use in specific contexts, as email is primarily meant for communication of message and not for education and training. In distance education, we can innovate in the areas of curriculum design, course development, delivery, and use of new technologies for teaching and learning.
- 2) Innovations take time to get adopted at different levels in the institutions. Everett Rogers, identified five types of individuals in organizations based on how they react/adopt technology/innovation. These are: innovators, early adopters, early majority, late majority, and laggards. Percentage-wise, 68% fall under early majority and late majority, which form the major group in any organization to make any innovation successful. So, strategies may be developed to get these people adopt innovation through training, and other processes of briefing and involvement.
- 3) i) The correct answer is (b), as copyright laws do not distinguish between works published online or in print. Internet, though available to all, is not a 'public domain'. Whether or not a copyright notice is given on a work, it is copyrighted, if otherwise expressed as available on creative commons or other open licenses. The year of copyright varies from country to country. But, it is normally 50 plus year after the death of the author.

- ii) The right answer is (c). A work in public domain may not be available online. And, webpages being available to anyone is not in public domain! Public libraries may have the work available in public domain, but it is also not necessarily so. And the use of public does not connote copyright is held by the society. As such copyrights are granted to individuals and group, and not to the whole society.
- iii) The correct answer is (d). Fair use/dealing clause in copyright laws allow us to use some portion of a copyrighted work for teaching, research, review and criticism purpose without taking permission of the copyright holder. Copying entire work without permission is violation of copyright. Normally teachers and students are allowed to use copyrighted works for under fair use clause as in (d), and also for one time use. But, this is not blanket permission. Materials available on the Internet should also be checked for their copyrights before use.



UNIT 5 STUDENT ASSESSMENT IN TECHNOLOGY ENHANCED LEARNING AND EVALUATION OF TECHNOLOGY

Structure

- 5.0 Introduction
- 5.1 Learning Outcomes
- 5.2 Assessment and Evaluation
 - 5.2.1 Technology in Assessment
 - 5.2.2 Evaluation of Technology
- 5.3 Media and Learning
 - 5.3.1 Role of Media in Learning
 - 5.3.2 Optimizing the Influence of Media in Learning
 - 5.3.3 Review of ‘No Significant Difference’ Phenomenon
- 5.4 Evaluation of Technology in Education: A Framework
- 5.5 Technology in Assessment: Examples
 - 5.5.1 Computer Assisted Assessment
 - 5.5.2 Online Assessment
 - 5.5.3 ePortfolio
 - 5.5.4 Making Assessment Authentic
- 5.6 Let Us Sum Up
- 5.7 Keywords
- 5.8 References and Further Readings
- 5.9 Feedback to Check Your Progress Questions

5.0 INTRODUCTION

A growing number of testing and learning experts argue that technology can dramatically improve assessment and thereby teaching and learning. Several new research projects are demonstrating how information technology can both deepen and broaden assessment practices in elementary and secondary education, by assessing more comprehensively and by assessing new skills and concepts. But technology alone cannot transform assessment. New approaches to assessment would have to be aligned with standards, curricula, professional development, and instruction. Still, the convergence of powerful new computer technologies and important new developments in cognitive science hold out the prospect of a new generation of student testing that could contribute to significant improvements in teaching and learning in the nation's classrooms (Tucker, 2009). In this background, we will discuss about assessment of students in technology enhanced learning environments, different types of technology supported assessments and evaluation of technology in educational context in the present unit.

5.1 LEARNING OUTCOMES

After working through this unit, you are expected to be able to:

- *Differentiate* assessment and evaluation in the context of technology;
- *Analyze* the research literature on media and learning;
- *Develop* and implement strategy for evaluation of technology use in education;

- *Describe* different ways of student assessment in ICT-enabled environment; and
- *Discuss* strengths and weaknesses of student assessment in technology-enabled environment.

5.2 ASSESSMENT AND EVALUATION

Talking about relationship between assessment and evaluation, Best & Khan (2006, p. 119) observes 'To assessment, evaluation adds the ingredient of the value judgment of the social utility, desirability, or effectiveness of a process, product or program, and it sometimes includes a recommendation for some course of action.' To make things clear, we can say that *we assess learning*, and *we evaluate results* in terms of some set of criteria. These two terms are certainly connected, but it is useful to think of them as separate but connected ideas and processes.

Assessment

The word "assessment" has taken on a variety of meanings within education system. We must understand that assessment is a process by which information is obtained relative to some known objective or goal.

Assessment is a broad term that includes testing. A test is a special form of assessment. Tests are assessments made under contrived circumstances especially so that they may be administered. In other words, all tests are assessments, but not all assessments are tests. A test or assessment yields information relative to an objective or goal. In that sense, we test or assess to determine whether or not an objective or goal has been obtained. The term 'assessment' generally refers to:

- the final learning outcomes of students that are the result of their learning activities in a course.
- the process teacher use to grade students' course assignments, or activities designed to collect information on the success of a course, a programme of study, or a university curriculum.
- standardized measures imposed on institutions as part of increased pressure for external accountability.

Assessment describes the status of a phenomenon at a particular time. It describes without value judgment a prevailing situation; it attempts no explanation of underlying reasons and makes no recommendations for action. It may deal with prevailing opinion, knowledge, practices, or conditions. As it is ordinarily used in education, assessment describes the progress students have made toward educational goals at a particular time (Best & Khan, 2006, p. 118). In sum, we can say that

- Assessment is an important way of students receiving feedback on their state of learning and it thus needs to be part of any effective course.
- Assessment helps us to know that whether the course itself is "working" for student learning, what is going well and what is not.

There are different types of assessment:

- a) Formative Assessment:** Feedback given to students to help their learning, for example, questions at the end of lectures is termed as formative assessment. Formative assessment can be self-assessment or peer-assessment as well as teacher assessment.
- b) Summative Assessment:** The results which are used to grade students at the end of a course are examples of summative assessment. We must keep in mind that at this point, feedback is too late, a grade is recorded.

- c) **Norm referenced Assessment:** An individual's performance in relation to the norms established by a peer group is termed as norm referenced assessment.
- d) **Criterion referenced Assessment:** Criterion referenced assessment takes place when a student is assessed on his or her ability to meet a required level of skill or competence.

Evaluation

Evaluation is a process used to determine what has happened during a given activity or in an institution. The purpose of evaluation is to see if a given programme is working, if an institution is successful according to the goals set for it, or if the original intent is being successfully carried out (Best & Khan, 2006, p. 119). Inherent in the idea of evaluation is "value." When we evaluate, what we are doing is engaging in some process that is designed to provide information that will help us make a judgment about a given situation. Teachers, in particular, are constantly evaluating students, and such evaluations are usually done in the context of comparisons between what was intended (learning, progress, behavior) and what was obtained.

During evaluation, we must keep in mind that

- The process will yield information regarding the worthiness, appropriateness, goodness, validity, legality, etc., of something for which a reliable measurement or assessment has been made.
- The process will require information about the situation that takes into account such ideas as objectives, goals, standards, procedures, and so on.

5.2.1 Technology in Assessment

We are now living in a technology driven world. As observed by Adelman (2000) "Increasingly, people have to know how to use technology to work and to learn. Thus, technology is becoming a substantive requirement in its own right. The emergence of technology as a necessary skill means there will be tests of it. For those who specialize in computing, such tests have become common for certifying job proficiency".

But as working and learning begin to require technology competence of almost everyone, assessing these skills will become routine. Perhaps more important for assessment, however, is that technology is also becoming a medium for learning and work (Bennett, 2002). The CEO Forum on Education and Technology (2001) suggests, "...as schools...integrate technology into the curriculum, the method of assessment should reflect the tools employed in teaching and learning." At the least, a mismatch between the modes of learning and assessment could cause achievement to be inaccurately estimated (Russell & Haney, 2000). Writing presents a good example: More and more, students are using the computer to complete composition assignments; however, research suggests that testing these students on paper underestimates their proficiency (Russell & Plati, 2001).

A number of promising research projects are beginning to explore the potential of technology to transform testing in more fundamental ways. They suggest that the technology-enabled assessment system is indeed possible—a system that's both deeper and broader, able to test knowledge and skills more thoroughly and to test skills and concepts that haven't been measured in the past, and a system that reflects far more fully what we know about how students learn (Tucker, 2009). These observations clearly indicate that as distance educators we must be ready to understand, learn and use technology for assessment purposes.

5.2.2 Evaluation of Technology

In recent decades, education has undergone a rapid revolution designed to meet the needs of the emerging information society. The use of technology in education and development of distance learning programs and courses have increased at a brisk pace. Today we offer a number of programmes where technology plays integral roles. Therefore, it is necessary to have criteria for evaluating relative appropriateness of various technology development or transfer strategies in order to determine appropriately meritorious technologies and associated development and transfer strategies. There are many factors that need to be considered in doing this (see Table 5.1).

Table 5.1: Evaluation Attributes of Technology (Dutton and Crowe, 1988)

Technological merit	• Technological objectives and significance • Breadth of interest of strategy • Potential for new discoveries and understandings • Uniqueness of proposed development strategy
Social benefits	• Contribution to improvement of the human condition • Contribution to national pride and prestige • Contribution to international understanding
Programmatic (management) issues	• Feasibility and readiness for development • Technological logistics and infrastructure • Technological community commitment and readiness • Institutional infrastructure and implications • International involvement • Cost of the proposed strategy

We are well aware about the fact that every technology has its own strengths and limitations. The other well known fact is that technology development consumes financial and other resources, often for a significant time period. Therefore, it is necessary for educators to get the maximum benefit of technology used for teaching learning process. Evaluation of technology in terms of utility, cost and time helps us to recognize the benefits of one particular technology in comparison to other available opportunities.

Check Your Progress 5.1

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

b) Compare your answer with the one given at the end of this unit.

Write True or False against the following sentences.

- Assessment provides opportunity of feedback to the learner.
- Assessment done at the end of the term is called formative assessment.
- Norm referenced assessment refers to the normative criteria set for assessment of learners.
- Evaluation refers to the process of determining the value or worth of an activity.
- Evaluation of technology helps us to understand utility, cost and appropriateness of technology for specific teaching and learning purpose.

5.3 MEDIA AND LEARNING

In technology enhanced learning environments, skillful integration of media with instructional method plays a very important role in achieving the intended learning outcomes. Different media serve to motivate students with clever use of sound, pictures and animation. Media also helps us in representing contexts and situations from the real world to bring into the classroom for live demonstrations.

Talking about the relationship of media and learning, Jonassen, Campbell and Davidson (1994), comments 'learning through a computer is not the same as learning from a book or learning from a lecture. They are all different forms of learning, and each results in a slightly different way of knowing about something. Deep understanding (or 'meaning') occurs when all forms of 'knowing' developed by a learner are internally reconciled and integrated by the learner. To put it in the language of constructivism, we need to focus on 'how media, however defined, can be used to facilitate knowledge-construction and meaning-making on the part of the learner'.

Media offers lot of opportunities to make learning more interesting and meaningful. The media helps us to bring 'outside world to the learners and learners to the outside world'. Commenting on the utility of ICTs for teaching learning process, Schank (1997) writes "Contemporary information and communications technologies offer some reprieve from the confines and constraints of conventional classrooms. They afford us opportunities to capture and/or represent real-world scenarios for use by learners within the conventional classroom. These representations can include actual images or simulations of complex phenomena from the field which can be a lot more easily integrated into the classroom curricula. They can be used as additional resources in lieu of actual field experience, or they can form a core component of the learning experience of students as is possible in the case of goal-based or problem-based learning, case-based reasoning or scenario based learning".

5.3.1 Review of 'No Significant Difference' Phenomenon

Most of us always want to know whether technology "makes a difference." Some of us will claim that using technology produces no significant difference; while some will say that technology has transformed education. To answer this question, Richard Clark (1983) reviewed the results of comparative research on educational media and claimed that they provide consistent evidence "... for the generalization that there are no learning benefits to be gained from employing any specific medium to deliver instruction" (p. 445). According to Clark, the results of those studies that appear to favor one medium over another are due not to the medium but to the method or content that are introduced along with the medium. Clark concludes that "... media do not influence learning under any conditions" (p. 445). Rather, "... media are mere vehicles that deliver instruction but do not influence student achievement any more than the truck that delivers our groceries causes changes in our nutrition" (p. 445).

Thomas Russell has also deliberated on this issue by cataloging at least 355 studies, technical reports, and dissertations that have reviewed student learning outcomes in the form of satisfaction surveys, grade comparisons, standardized test scores, common embedded questions, frequency of interaction between students and faculty, and a dizzying array of other "measures" ostensibly aimed at determining if any measurable or

statistically significant differences exist (Russell, 2001). Here we must keep in mind that 355 reports contained in Russell's "No Significant Difference Phenomenon" website have focused primarily on differences in the media rather than the methods employed *via* the medium. Russell's collection highlights the fact that great majority of studies have found *no significant difference* (with "significance" being used here as a statistical term) in student outcomes when the independent variable was the method of course delivery.

The debate about whether technology makes an impact on teaching learning process is still on and undecided. Conger (2005) gives us a very interesting observation on this issue "with two opposing camps having access to the same data, it is no surprise that a shift in emphasis allows this finding to be interpreted in two different ways. One interpretation holds that the use of technology to deliver courses does no harm – that is, face to face learning has no inherent advantage to students over learning at a distance. The other interpretation is that technology *does not help* – and if a course can be delivered for less expense without technology, there is no need to use technology at all".

5.3.2 Role of Media in Learning

Digital literacy and media sophistication is becoming necessary to succeed in every aspect of life. So it is critical that education focus much of its effort in teaching the new digital literacies as well as the old literacies of reading, writing, and arithmetic. As new technologies in society create demands for educating students in new skills, new media support the teaching of these skills better than more traditional instructional methods. So as the demands on education change, understanding how to use new media to teach new skills is critical (Collins et al, 2000).

When using media within learning environments, particularly e-learning environments, it is important to recognize the way media is processed by the brain. The learner can experience a cognitive overload with too much media. Essentially the idea of more media is not necessarily the best for learning. Understanding about how the brain processes images (and animations), text, and sound; and what are the best approaches to using these media together is helpful to understand the role of media in learning. The work of Mayer and Moreno (2000) provides valuable insight on this aspect.

These learning environments skillfully utilize the strengths of various media attributes with powerful learning strategies such as problem solving, collaborative inquiry and critical reflection to engage learners in meaningful and motivating learning tasks. In such educational settings media take on a very important role in both learning and teaching. Learning and teaching is adversely affected when media are not skillfully integrated into the learning experiences. Conversely, learning and teaching is optimized when media have been carefully selected and applied with sound instructional strategies to serve specific learning needs in different domains of learning (Naidu, 2006, p.14).

Kozma (1994) offers us a valuable advice to understand the role of media in learning by proposing that "we must ground a theory of media in the cognitive and social processes by which knowledge is constructed, we must define media in ways that are compatible and complementary with these processes, we must conduct research on the mechanisms by which characteristics of media might interact with and influence these processes, and we must design our interventions in ways that embed media in these processes".

5.3.3 Optimizing the Influence of Media in Learning

Skillful integration of media and instructional method (i.e., learning and teaching strategies) is critical in the optimization of the influence of media in learning. This requires careful selection and matching of media attributes with learning and teaching strategies. Contemporary information and communications technologies afford a wide range and variety of opportunities to rethink and reengineer the nature of our teaching and learning practices. Learner and learning-centered educational environments are those where the learner and the learning process is the focus of programme design, development and delivery. In such educational settings, the learner - not the teacher, organization, or technology - is in charge of the learning experience.

Learner and learning-centered educational processes are defining characteristics of situated learning environments. The concept of situated learning is grounded in the principles of constructivist learning theory (Wilson, 1996). It is based on the belief that learning is most efficient and effective when it takes place within the context of realistic educational settings which are either real or contrived (Brown, Collins, & Duguid, 1989). The roots of situated approaches to education and training are traceable to the concepts of experiential learning (Dewey, 1958), and problem based learning (Barrows, 1994; Kohler, 1925, Koffka, 1935; Orrill, 2000). Exemplar situated learning environments use “authentic learning tasks” to immerse learners in the total ecology and culture of the subject matter that is being taught and learned, much like an apprentice carpenter is immersed in a building site with architects and experienced builders (Brown, Collins, & Duguid, 1989). These so called authentic learning tasks serve to “anchor” learning and teaching activities in order to scaffold learning and cognition (The Cognition and Technology Group at Vanderbilt, 1990). You have studies about these in Unit-3.

The notions of situated learning and the use of authentic learning tasks that serve to anchor and scaffold learning and teaching are heavily dependent on the use of real-world or contrived educational activities that adequately reflect real-world settings. These sorts of educational activities are inherently complex and as such time-consuming to manage. They are harder to integrate into conventional classroom settings which are limited by the opportunities they afford to engage students in authentic real-world problem-solving. While field trips and excursions offer occasional and limited opportunities, they are not enough. Therefore many teachers and organizations refrain from engaging in situated learning activities in their classes and instead depend on approaches that are a lot more expedient and teacher and subject matter.

According to Naidu (2006, p.13) “the medium is not inert and it does not exist independently of the learning context and the subject matter content. In fact, when it is carefully integrated into the learning experience, the medium often interacts with the instructional method to produce the intended learning outcomes for the students in a given learning context. Therefore the media used, along with the instructional method would seem to have an influence on learning”.

We have a number of advises to optimize the influence of media in learning propounded by different educationists. Among these educationists, Kozma, (1994) offers very good advice on the issue “I believe that if we move from “Do media influence learning?” to “In what ways can we use the capabilities

of media to influence learning for particular students, tasks, and situations?" we will both advance the development of our field and contribute to the restructuring of schools and the improvement of education and training".

Check Your Progress 5.2

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

b) Compare your answer with the one given at the end of this unit.

Explain the meaning of 'no significant difference' in about 150 words.

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5.4 EVALUATION OF TECHNOLOGY IN EDUCATION: A FRAMEWORK

The major problems to evaluate many e-learning programmes has proven to be handling the number of variables which potentially impact on the effectiveness of the programme and deciding what constitutes dependent, independent and irrelevant variables in a given situation. According to Hughes and Attwell (2003), over several e-learning evaluation projects, five major clusters of variables have emerged: individual learner variables, environmental variables, technology variables, contextual variables and pedagogic variables.

Individual learner variables include physical characteristics, learning history, learner attitude, learner motivation, and familiarity with the technology. On the other hand, learning environment variables include the immediate (physical) learning environment, the organizational or institutional environment and the subject environment. *Contextual variables* include socio-economic factors, the political context and cultural background. *Technology variables* have been identified as the kind of hardware and software used and the connectivity, media and mode of delivery employed. *Pedagogic variables* touch on issues concerned with the level and nature of learner support systems, accessibility issues, methodologies employed, flexibility, learner autonomy, selection and recruitment criteria, assessment and examination, and accreditation and certification issues.

Further deliberating on this issue, Omwenga and Rodrigues (2006) identified following three matrix items (levels and components) for Evaluation of Technology in Education framework:

Level 1 *The system's functioning (Technical).* This has been referred to as the raw efficiency of the system.

Level 2 *Human perspectives.* This includes the acceptability of the system by the various stakeholders (*The Instructor, The Learner and The Administrator*) and considers how the system's functions affect them.

Level 3 Education system. This involves a consideration of the impact of a system's use on the education system as a whole, and on e-learning itself. It concerns the national developmental level in its widest possible sense.

Omwenga and Rodrigues (2006) further concluded that the evaluation of e-learning is fundamentally the same as the evaluation of any other learning but with particular groups of variables playing a more prominent role and the impact of others differing significantly from their impact in traditional learning.

5.5 TECHNOLOGY IN ASSESSMENT: EXAMPLES

A growing number of testing and learning experts argue that technology can dramatically improve assessment—and teaching and learning. Tucker (2009) observes 'These new technology-enabled assessments offer the potential to understand more than whether a student answered a test question right or wrong. Using multiple forms of media that allow for both visual and graphical representations, we can present complex, multi-step problems for students to solve, and we can collect detailed information about an individual student's approach to problem solving. This information may allow educators to better comprehend how students arrive at their answers and learn what those pathways reveal about students' grasp of underlying concepts, as well as to discover how they can alter their instruction to help move students forward'.

Some examples based on Technology in assessment are:

- One of the largest efforts to pilot new forms of technology-based assessment is the Problem Solving in Technology-Rich Environments (TRE) project. TRE tested scientific inquiry skills such as the ability to find information about a given topic, judge what information is relevant, plan and conduct experiments, monitor one's efforts, organize and interpret results, and communicate a coherent interpretation. (Tucker, 2009).
- Another example of technology-enabled assessment being used in science education is Floaters, a test given to students as part of the World Class Tests optional assessment program in the United Kingdom. The international initiative uses highly visual, engaging questions, enabling young students to be tested on an aspect of scientific method in a way not possible using paper and pencil (Tucker, 2009).
- The River City project, led by Harvard education professor Chris Dede, is a multi-user, virtual environment where middle-school students explore a mysterious illness in a turn-of-the-century town. Students learn by becoming scientists in River City's virtual world. With the project focused on inquiry practices, students make observations, "chat" with townspeople, develop hypotheses, and conduct experiments to determine the cause of the epidemic (Dede, 2007).

The bottom line is that, as students come to do the majority of their learning with technology, asking them to express that learning in a medium different from the one in which they routinely work will become increasingly untenable, to the point that much of the paper testing we do today will be an anachronism (Bennett, 2001).

5.5.1 Computer Assisted Assessment

Computer Assisted assessment (CAA) is a common term for the use of computers in the assessment of student learning. Various other forms exist, such as Computer-Aided Assessment, computerized assessment, Computer Based assessment (CBA) and computer-based testing. Online Computer Based Assessment has existed for a long time in the form of Multiple Choice Questions (MCQs). Computer Based Assessment is commonly made directly via a computer, whereas Computer Assisted Assessment is used to manage or support the assessment process. Examples are the optical mark reader used to score MCQs and database programs used to record student marks.

Computer Assisted Assessment is usually formative and criterion referenced as it helps students to discover whether they have learned what the educator intended and provide timely feedback on how best to teach a subject. Increasingly, it can be summative, with limited feedback typically being given at the end of a course and serving to grade and categorize the student's work. It can also be diagnostic, eg. by testing for pre-knowledge.

5.5.2 Online Assessment

The term online learning (or, as it is sometimes called, distance learning) includes a number of computer-assisted instruction methods. In simple terms, online teaching and learning is faculty-delivered instruction via the Internet. Online instruction includes real-time (synchronous) and anytime, anywhere (asynchronous) interactions.

Two parallel processes take place in an online learning environment:

- Students become more active, reflective learners.
- Students and teachers engage in learning through the use of technology and become more familiar with technology by using it.

In assessing online learning, it is important to create a "mix" of assignments that cover the multiple dimensions of learning that online courses can employ. Traditional tests become a smaller part of the grade as we move towards encouraging student interaction on group projects and other activities.

Different Forms of Online Assessment	
Forms of Online Assessment	• End of semester paper
	• Weekly tests
	• Group projects
	• Case study analysis
	• Reading responses
	• Chatroom responses
	• Threaded discussions participation
	• Virtual presentations/ Online Seminar

With the growth of online education, there is naturally growing interest in online assessment tools. A quick search on the Internet will reveal a great deal of information. Moreover, most prominent Learning Management Systems (LMS), such as Blackboard and Moodle come with built-in assessment tools which allow the development of questions and surveys with objective type as well as open-ended responses. These are useful in online education as they enable frequent testing and provision of feedback. However, they remain somewhat unsuited for assessing more complex learning activities such as group work and project work (Naidu, 2006, pp. 33-34).

5.5.3 ePortfolio

An electronic portfolio, also known as an e-portfolio or digital portfolio, is a collection of electronic evidence assembled and managed by a user, usually on the web (also called webfolio). An eportfolio can be a web-based information management system that uses electronic media and services. The learner builds and maintains a digital repository of artifacts, which they can use to demonstrate competence and reflect on their learning. Having access to their records, digital repository, feedback and reflection students can achieve a greater understanding of their individual growth, career planning and CV building. Accreditation for prior and/or extra-curricular experiences and control over access makes the eportfolio a powerful tool (ePortfolio Australia, n.d.)

There is a difference however, between eportfolios and webfolios. Since the mid-90s, the term eportfolio has been used to describe collections of student work at a Web site. Within the field of composition studies, the term “webfolio” has also been used. Webfolios are static Web sites where functionality derives from HTML links. ePortfolio therefore, now refers to database-driven, dynamic web sites, not static, HTML-driven sites (Batson, 2002).

An e-portfolio can be seen in two ways:

- As electronic evidence that may include inputted text, electronic files, images, multimedia, blog entries, and hyperlinks.
- As a type of learning record that provides actual evidence of achievement.

E-portfolios are both demonstrations of the user’s abilities and platforms for self-expression, and, if they are online, they can be maintained dynamically over time. Some e-portfolio applications permit varying degrees of audience access, so the same portfolio might be used for multiple purposes. E-portfolios, like traditional portfolios, can facilitate students’ reflection on their own learning, leading to more awareness of learning strategies and needs. In this context, the use of an electronic portfolio helps us to achieve better learning outcomes.

5.5.4 Making Assessment Authentic

Authentic assessment is a form of assessment in which students are asked to perform real-world tasks that demonstrate meaningful application of essential knowledge and skills. Or, as Grant Wiggins (1993) describes it, authentic measures are “engaging and worthy problems or questions of importance, in which students must use knowledge to fashion performances effectively and creatively. The tasks are either replicas of or analogous to the kinds of problems faced by adult citizens and consumers or professionals in the field.”

Cormack (n.d.) identified six key aspects of authentic assessment. According to him, the term ‘authentic’ was seen to imply assessment that:

- connects assessment to the curriculum
- engages students, teachers and others in assessing performance
- looks beyond the school for models and sites of action
- promotes complex thinking and problem solving
- encourages student ‘performance’ of their learning
- engages with issues of equity

In authentic assessment, assessment drives the curriculum. In authentic assessment, teachers first determine the tasks that students will perform to demonstrate their mastery, and then a curriculum is developed that will enable students to perform those tasks well, which would include the acquisition of essential knowledge and skills. This has been referred to as *planning backwards* (McDonald, 1992).

One of the advantages that teachers see in authentic assessment is the flexibility it provides to design curriculum and assessment tasks that are more likely to engage student's interests and to involve students in active, performative learning. While most of the traditional assessment tasks involved students in sitting down at a desk using a pen and paper, this was typically as an adjunct to activities that involved students in doing, designing, making, talking and producing. There is the potential for such an active approach to engage students who do not succeed in traditional classroom environments. As the nature of work and leisure changes outside the school there are very real pressures on teachers to adapt their curriculum accordingly. The authentic assessment approaches trialed by the schools seem to offer hope that teachers can adapt their assessment practices to new, non-traditional kinds of school work for increasingly diverse student populations (Cormack, n.d.).

Check Your Progress 5.3

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

b) Compare your answer with the one given at the end of this unit.

Write True or False against the following sentences.

- a) Online multiple choice quiz can be used as formative assessment only.
- b) Discussion forums are good online assessment tool for critical thinking and reflection.
- c) ePortfolio provides a powerful system to record student achievement over a period of time.
- d) ePortfolio can demonstrate student skills and are effective for vocational courses.
- e) For assessment to be authentic, it should be done face-to-face.
- f) Authentic assessments are highly aligned to measure achievement of objectives.

5.6 LET US SUM UP

In this unit, we have learnt about number of things. Let's have a look on these to review:

- Assessment is an important way of students receiving feedback on their state of learning and it thus needs to be part of any effective course.
- The purpose of evaluation is to see if a given program is working, if an institution is successful according to the goals set for it, or if the original intent is being successfully carried out.
- A number of promising research projects are beginning to explore the potential of technology to transform testing and suggest that the technology-enabled assessment system is indeed possible.

- It is necessary to have criteria for evaluating relative appropriateness of various technology development or transfer strategies in order to determine appropriately meritorious technologies for teaching learning purposes.
- Media plays a very important role in achieving the intended learning outcomes for the students by motivating them with clever use of sound, pictures and animation.
- Regarding use of technology, one interpretation holds that the use of technology to deliver courses *does no harm* and the other interpretation is that technology *does not help*.
- Skillful integration of media and instructional method (i.e., learning and teaching strategies) is critical in the optimization of the influence of media in learning.
- New technology-enabled assessments offer the potential to understand more than whether a student answered a test question right or wrong.
- Convergence of powerful new computer technologies and important new developments in cognitive science hold out the prospect of a new generation of student testing.
- Computer Assisted Assessment helps students to discover whether they have learned what the educator intended and provide timely feedback on how best to teach a subject.
- Online assessment takes help from “mix” of assignments that cover the multiple dimensions of learning.
- E-portfolios are both demonstrations of the user’s abilities and platforms for self-expression, and, if they are online, they can be maintained dynamically over time.
- An authentic assessment usually includes a task for students to perform and instructions by which their performance on the task will be evaluated.

5.7 KEYWORDS

Assessment: Testing/evaluating student performance and providing feedback to students for grading purposes.

Authentic Assessment: Authentic assessment is a form of assessment in which students are asked to perform real-world tasks that demonstrate meaningful application of essential knowledge and skills.

Computer Assisted Assessment: Computer Assisted assessment (CAA) is a common term for the use of computers in the assessment of student learning.

electronic portfolio: electronic portfolio (also known as an e-portfolio or digital portfolio) help learners to build and maintain a digital repository of artifacts, which they can use to demonstrate competence and reflect on their learning.

Evaluation of Technology in Education: Evaluation of technology in education means to ascertain the extent to which the technology is integrated into regular teaching and learning activities.

Evaluation of Technology: Evaluating relative appropriateness of various technologies in order to determine appropriately meritorious technologies and associated development and transfer strategies.

Evaluation: A process used to determine what has happened during a given activity or in an institution.

Online Assessment: Majority of online learning management systems come with built-in assessment tools which allow the development of questions and surveys with objective type as well as open-ended responses.

Technology in Assessment: Means using multiple forms of media that allow for both visual and graphical representations to present complex, multi-step problems for students to solve, and to collect detailed information about an individual student's approach to problem solving.

Technology of Assessment: Using multiple forms of technology to present complex, multi-step problems for students to solve, so that we can collect detailed information about an individual student's approach to problem solving.

5.8 REFERENCES AND FURTHER READINGS

- Adelman, C. (2000). A parallel postsecondary universe: The certification system in information technology. Retrieved June 26, 2009, from the U.S. Department of Education Web site: <http://www.ed.gov/pubs/ParallelUniverse>.
- Barrows, H. S. (1994). *Problem-Based Learning Applied to Medical Education*. School of Medicine, Springfield, IL: Southern Illinois University.
- Bennett, R. E. (2001). How the Internet will help large-scale assessment reinvent itself. *Education Policy Analysis Archives*, 9(5). Retrieved April 27, 2009, from Web site:
- Bennett, R.E. (2002). Inexorable and inevitable: The continuing story of technology and assessment. *Journal of Technology, Learning, and Assessment*, 1(1). Retrieved April 27, 2009, from Web site: <http://www.jtla.org>.
- Best, J.W. & Kahn, J.V. (2006). *Research in Education* (10th Edition). New Delhi: Prentice Hall of India Pvt. Ltd.
- Biggs, J. (1999). *Teaching for quality learning at University*. Buckingham, UK: Open University Press
- Brown, J. S., Collins, A., & Duguid, P. (1989). Situated cognition and the culture of learning. *Educational Researcher*, January-February, 32-42.
- CEO Forum on Education and Technology. (2001). *School technology and readiness—Key building blocks for student achievement in the 21st century: Assessment, alignment, accountability, access, analysis*. Retrieved June 26, 2009, from Web site: <http://www.ceoforum.org/downloads/report4.pdf>
- Clark, R. (1983). Reconsidering research on learning from media. *Review of Educational Research*, 53(4), 445-459.
- Collins. A., Nevile. P. & Bielaczyc, K. (2000). The Role of Different Media in Designing Learning Environments. *International Journal of Artificial Intelligence in Education*, 11, 144-162
- Conger, S.B. (2005). Conger, S. B. (2005). If There Is No Significant Difference, Why Should We. Care? *The Journal of Educators Online*, 2(2).
- Cormack, P. (n.d.). Making assessment authentic: Questions and challenges for middle years research and practice. Retrieved June 29, 2009, from Web site: <http://www.aare.edu.au/97pap/cormp225.htm>
- Dede, C. (2007). Transforming Education for the 21st Century: New Pedagogies that Help All Students Attain Sophisticated Learning Outcomes. Commissioned by the NCSU Friday Institute. Retrieved June 26, 2009, from Web site: http://www.gse.harvard.edu/~dedech/Dede_21stC-skills_semi-final.pdf.
- Dewey, J. (1958). *Experience and education*. New York: Macmill
- Dutton, J.A., & L. Crowe (1988). Setting Priorities among Scientific Initiatives. *American Scientist* 76 (November): 599-603.
- ePortfolio Australia (n.d.). What is an ePortfolio. Retrieved from Web site: <http://www.eportfolio.editaustralia.com.au/>
- <http://epaa.asu.edu/epaa/v9n5.html>
- Hughes, J., & Attwell, G. (2003). A framework for the Evaluation of E-Learning. European Seminar Series on Exploring Models and Partnerships for eLearning in SMEs, Brussels.
- Jonassen, D.H., Campbell, J.P., & Davidson, M.E. (1994). Learning with media restructuring the Debate. *Educational Technology Research & Development*, 42(2), 31-39.

- Koffka, K. (1935). *Principles of Gestalt Psychology*. New York: Harcourt, Brace & World.
- Kohler, W. (1929). *Gestalt Psychology*. New York: Liveright.
- Kozma, R. (1994). Will media influence learning: Reframing the debate. *Educational Technology Research and Development*, 42(2), 7-19.
- Mayer, R. E. & Moreno, R. (2000). A Learner-Centered Approach to Multimedia Explanations: Deriving Instructional Design Principles from Cognitive Theory. *Interactive Multimedia Electronic Journal of Computer-Enhanced Learning*, 2(2).
- McDonald, J. P. (1992). Dilemmas of planning backwards: Rescuing a good idea. *Teachers College Record*, 94, 152-169.
- Naidu, S. (2006). *E-Learning -A Guidebook of Principles, Procedures and Practices*. New Delhi: Commonwealth Educational Media Center for Asia.
- Omwenga, E. I. & Rodrigues, A. (2006). Towards an Education Evaluation Framework: Synchronous and Asynchronous E-learning Cases. *Journal of the Research Centre for Educational Technology*, 2(1). Retrieved May 25, 2009, from Web site: <http://www.rcetj.org/Default.aspx?type=art&id=4756>
- Orrill, C. H. (2000). 'Designing a PBL experience for online delivery in a six- week course'. In S. Sage (Chair), Problem-based learning in an online instructional technology course. Paper presented at the annual meeting of the American Educational Research Association, New Orleans.
- Race, P. (1995). 'What has assessment done for us – and to us?'. In P Knight(Ed.) *Assessment for Learning in Higher Education*. London: SEDA/Kogan Page.
- Ramsden (1992). *Learning to teach in Higher Education*. London: Routledge
- Russell, M., & Haney, W. (2000). Bridging the gap between testing and technology in schools. *Education Policy Analysis Archives*, 8(19). Retrieved June 26, 2009 from Web site: <http://epaa.asu.edu/epaa/v8n9.html>
- Russell, M., & Plati, T. (2001). Effects of computer versus paper administration of a state-mandated writing assessment. Retrieved June 26, 2009, from Web site: <http://www.tcrecord.org/Content.asp?ContentID=y0709>
- Russell, T. (2001). The "No Significant Difference Phenomenon". Retrieved June 26, 2009, from Web site: <http://teleeducation.nb.ca/nosignificantdifference/>
- Schank, R. (1997). *Virtual learning: A revolutionary approach to building a highly skilled workforce*. New York: McGraw-Hill.
- The Cognition and Technology Group at Vanderbilt (1993). The Jasper Experiment: Using video to provide real-world problem-solving contexts. *Arithmetic Teacher*, 40, 474-478.
- Tucker, B. (2009). Beyond the Bubble: Technology and the Future of Student Assessment. *Education Sector Reports*. Retrieved April 07, 2009, from Web site: www.educationsector.org.
- Wiggins, G.P. (1993). *Assessing Student Performance*. San Francisco: Jossey-Bass Publishers.
- Wilson, B. G. (Ed.). (1996). *Constructivist learning environments: Case studies in instructional design*. Englewood Cliffs, New Jersey: Educational Technology Publications.

5.9 CHECK YOUR PROGRESS: POSSIBLE ANSWERS

Check Your Progress 5.1

- True. Through assessment, we can provide feedback to the learners about their progress in a course or programme of study.
- False. Assessment at the end of the term is referred as 'Summative assessment'. Formative assessment is done during the course of study to help the learner understand his/her progress and take corrective measures.
- False. Norm referenced assessment refers to the group as the norm, coming of the normal distribution curve, where as criterion referenced assessment places emphasis of the objectives to be achieved by each learner.

- d) True. Overall evaluation is to add value to the process of assessment and judge something for its worthiness.
- e) True. Only through evaluation of technology, we can know the actual 'fitness for purpose' of the same.

Check Your Progress 5.2

Media has numerous advantages in learning. Skillful integration of media in teaching and learning plays important role in motivating the learners; drawing their attention; and providing complex topics through simple visual illustrations. However, comparative research on educational media by Richard Clarke revealed that media do not influence learning. Continuing this, Thomas Russell identified over 350 studies that reported 'no significant difference' in learning due to use of media in comparison to face-to-face teaching. This in fact is also one of the strong arguments in favour of distance learning that uses media heavily. It also indicates that research on student learning from media should focus on the methods and design rather than on the media itself. For example, a badly designed video may be less effective than a very good lecture or well illustrated self learning material in print. Media is not inert and do not exist independently of its context. It is the instructional methods and the use of media that are more important in improving learning. Therefore, it is more significant to focus on the strength of a media and its proper design in context than on the media alone.

Check Your Progress 5.3

- a) False. This is a tricky one. While online multiple choice quiz can be used for formative assessment, it is also used for summative assessment purpose depending on the course design. So, we can not say that it can be used only for formative assessment.
- b) True. Discussion forums provide learners the opportunity to think and express ideas in their own words, and engage them in discussions in an asynchronous manner.
- c) True. ePortfolios are personal online tools to showcase student achievements and are used to demonstrate to potential employer what the student has done during his/her studies.
- d) True. As mentioned above in (c), student skills gathered can be demonstrated online. For example computer programming, drawings, illustrations, etc.
- e) False. Authentic does not have to be face-to-face. Authentic means the assessment task should be related to what the learners is supposed to learn.
- e) True. When you prepare assessment tasks in relation to the objectives of the course, you are actually doing authentic assessment. Authentic means going as real as possible.



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STAFF TRAINING AND RESEARCH INSTITUTE OF DISTANCE EDUCATION

Dear Learner,

While studying the units of this block, you may have found certain portions of the text difficult to comprehend. We wish to know your difficulties and suggestions, in order to improve the course. Therefore, we request you to fill out and send us this from as soon as you complete reading this block. Kindly use a separate sheet, if you find the space provided insufficient.

Please mail to:

Course Coordinator (MDE-418)
STRIDE, IGNOU, Maidan Garhi
New Delhi – 110068, India

Questionnaire

Enrolment No.

- 1) How many hours did you need for studying the units?

Unit no.	1	2	3	4	5
No. of hours					

- 2) In the following table we have listed 4 kinds of difficulties that we thought you might have come across. Kindly tick (✓) the type of difficulty and give the relevant page number in appropriate columns.

Page Number and Line Number	Type of Difficulties			
	Presentation is not clear	Language is difficult	Diagram is not clear	Words/Terms are not explained

- 3) It is possible that you could not attempt some CYPs. In the following table some possible difficulties are listed. Kindly tick (✓) the type of difficulty and the relevant unit and question numbers in appropriate columns.

Unit No.	CYP No.	Question Not-clearly posed	Type of difficulty		
			Cannot answer on the basis of information	Answer given (at the end of unit) not clear	Answer given is not sufficient

- 4) Any other comment:-