UNIT 4 EVOLUTION OF EDUCATIONAL TECHNOLOGY: TECHNOLOGY OF EDUCATION AND TECHNOLOGY IN EDUCATION

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4.1 INTRODUCTION

We all know that some teachers teach better by utilising new methods and techniques. Some other teachers teach with some age old methods without looking back whether their teaching is effective. Over the years, teachers and researchers have developed and used many techniques, methods and equipments to make the process of learning effective. This process of developing and using scientific methods, media and techniques for raising the effectiveness of teaching and learning is essential for educational technology.

In this unit, you will deepen your understanding about Educational Technology (E.T.) by further distinguishing between various aspects of Educational Technology. You will be able to differentiate between technology of education and technology in education. Since many technologies are used at school level, you as a teacher will be able to list down the different hardware and software used at the school level.

4.2 OBJECTIVES

After going through this unit, you will be able to:
- define the meaning and scope of educational technology;
- differentiate between Technology of Education and Technology in Education;
- list down the hardware and software, separately, that have been in use at the school stage; and
- describe the evolution of educational technology.
4.3 MEANING OF EDUCATIONAL TECHNOLOGY

Before reading the following para, define the meaning of education and meaning of technology separately. You may consult any dictionary for this.

The meaning which you have written may be as follows:

Education: Education is not only external arrangement by a trainer e.g. training of a dog, it is a process of changing human behaviour in the desirable direction or helping an individual to bring out (educate) his/her best potential;

Technology: It is a systemic study of techniques, and methods applied to achieve an objective. You may also say that it is that branch of knowledge that deals with industrial arts, applied science, engineering, etc.

Combining the two you may try to derive the meaning of educational technology. Before doing that you will try to review some of the definitions given by experts.

The National Council for Educational Technology (1967) has defined educational technology as “the development, application, and evaluation of systems, techniques and aids to improve the process of human learning. Therefore, educational technology means not only the hardware or machines, but also all those processes which help in human learning.

A more comprehensive definition that is given by Leith is that “Educational Technology is the application of scientific knowledge about learning and conditions of learning, to improve the effectiveness and efficiency of teaching and learning. In the absence of scientifically established principles, educational technology implements techniques of empirical testing to improve learning situation.” Here the scientific knowledge of teaching-learning refers to the following.

T. Sakamato has defined educational technology as “an applied or practical study which aims at maximum educational effect by controlling such relevant facts as educational purposes, educational contents, teaching materials, methods, educational environment, conducts of students, behaviour of instructors and interrelation between students and instructors”. In this definition emphasis has been given to the input, process and output aspects of education.

Unwin (1969) has also defined educational technology as “the application of modern skills and techniques to the requirements of education and training. This includes the facilitation of learning by manipulation of media and methods, and the control of environment so far as this reflects on learning”. An analysis of this definition pointed out that educational technology is:

1. an application of modern skills and techniques in view of the objectives.
2. facilitation of learning by methods and media.
3. control of environment for effective learning.

An analysis of all the definitions, and in the light of the meaning of education and technology written separately by you, may suggest that “Educational Technology is a science of techniques and methods by which educational goals can be realised”.

You will be able to understand the meaning of educational technology better by going through the characteristics of educational technology as listed below.

Characteristics of Educational Technology

1. It includes input, process and output aspects of education.
2. It stresses upon developing methods and techniques for effective learning.
3. It is an application of scientific knowledge to education and training.
4. It includes organisation of learning conditions for realising the goals of education.
5. It emphasises designing and measuring instruments for testing learning outcomes.
6. It facilitates learning by controlling environment, media and methods.
4.3.1 Technology of Education

Technology of education deals with the active use of all the systematic application of the resources of scientific knowledge of the process of learning that each individual has to pass through in order to acquire and use knowledge. It also includes decisions about the educational objectives to be achieved and decisions about the size of the learning groups, learning sequence, teaching methods and selection of media. It also embraces the selective use of media, personnel, knowledge, ideas and resources in the systematic planning, designing, production, management and evaluation of the educational process.

4.3.2 Technology in Education

Technology in Education refers to the use of technological hardware in education. It is mainly concerned with electrical and electronic gadgets which are used to facilitate the teaching-learning process. Saettler (1978) distinguishes between technology of education and technology in education. According to him, the former is a behavioural science conception whereas the latter is a machine (device) conception of educational technology. Radio, Television, OHP, Computer, Tape Recorder, etc., constitute technology in education, whereas the radio programmes, television programmes, computer programmes, OHP transparencies which are based on scientific knowledge of education constitute technology of education.

Check Your Progress

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

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

1. What do you mean by educational technology?

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

4.4 HARDWARE AND SOFTWARE ASPECTS OF EDUCATIONAL TECHNOLOGY

Educational technology as an amalgam of hardware and software is a known fact in the sense that essentially hardware covers TV, computer, overhead projector, tape recorder, and teaching machines. The other aspect, i.e., software, includes audio-video cassettes, filmstrips, transparencies, microfilm, slides, and so on. In the absence of these software gadgets hardware alone can hardly satisfy the educational requirements. Therefore, both the aspects of educational technology are closely intertwined to serve the cause of education. From the above discussion you may find that hardware is based on the principles of engineering technology and software is based on psychological and sociological principles. In your school you may find many technologies which are available and used by the teachers regularly. Most of the schools have a blackboard and a chalk (both hardware) while that which is written on it (chart, paragraph etc.) is the software. You may also realise that these technologies are used by teachers and students mostly in combination rather than in isolation.

Text Activity

1. List separately, the hardware and software present in your school.
4.5 SCOPE OF EDUCATIONAL TECHNOLOGY

**Activity:** You have read above that educational technology is not a new concept. And as a teacher, you are acquainted with the use of educational technology. Now, for better understanding of the scope of educational technology, recall your experiences in the classroom and write some items as to what according to you are within the scope of educational technology. While reading please check the new points that you have not written.

Educational technology as you know is used to raise the efficiency of education. But with the passage of time, the system of education is facing new problems to be tackled. So, the hardware and software of educational technology are ever expanding. Therefore, the application of educational technology is much more than what it was a few decades back. Following are some of the applications of educational technology that are worth noting.

**Mass education:** There has been explosion of population and knowledge. There is, therefore, a need to educate the masses. The problem is multiplied further by having a large section of illiterate people. So, educational technology has a tremendous application to educate a large section of people and impart a large amount of knowledge in a limited span of time. In this regard, the mass media viz., TV, radio, newspaper and other modern technologies like computers and information technology (E-mail, internet, etc.) has a lot of scope. The illiterate masses can also be made literate with the help of innovative methods and practices of teaching and learning.

**Historical information:** Any branch of knowledge that we deal with has a historical base. Such information is of tremendous importance for the students to understand any branch of knowledge in its totality. Such incidents when occur can be recorded with the help of audio-video cassette or documented in the form of a written or printed material. Such documents become the source of information for learners to learn. The main advantage of such documents is that we cannot create or repeat the history once more howsoever we try hard and place it before the learners. For example, can we have the same view of the explosion of Hiroshima and Nagasaki (1946) and show it to our students? This is neither feasible nor possible. Further, for example, we cannot have the same view of Nuclear test conducted at Pokhran (1998). So such records........in the form of a film taken when the incident is happening are of immense value to the learners which educational technology can only provide.

**Costly and hazardous experiments:** In many fields of science and technology there are some experiments having great implications for effective learning which are not advisable for the teacher to conduct in the classroom because of cost and health hazards involved. Such experiments, once conducted carefully in the laboratory or elsewhere can be recorded with the help of new electronic technology and be used by teachers and students for effective learning.

**Gaming and simulation:** If historical events which are either costly or hazardous which cannot be conducted, then educational technology can rescue us by doing the same through simulation. Computer technology in this regard plays a main role. This can provide a lifelike picture of phenomena in three dimensions. It can also show the operation of different parts of a phenomenon and the consequences. The other possibility is games. Children can learn, through play, many concepts that just cannot be taught in the formal set of the classroom. The gaming and simulation has a great scope in the training of military personnel and in the field of aviation.

**Distance education:** Educational technology has a great scope in distance education and open school programme (Go through the chapter on Open School in Block 1, Unit 2). Today there is a great need for personnel training and education on regular basis for updating oneself in the field of work. In this regard, distance education programmes, a relatively less formal process of education, have acquired new status. Educational technology with its innovative practices can educate the learners who cannot come to the classroom setup for their education. In this regard programmed learning materials, modules, contact programme, and counselling are some innovations which can help distance learners.

**Collection, storing and retrieval of information:** There are certain cameras which provide us the facility to take same photographs of events that take place in a fraction of second, events that occur at a far off place, those that cannot be seen by the naked eye. There are also satellites that work for us day and night to provide us information about places which are not accessible to us. Information can be collected with the help of this new electronic technology.
both in audio and in video form. Such information can be stored with magnetic and electronic devices easily and can be retrieved within no time.

**Research:** As mentioned earlier, information can be collected and stored to be used for educational purposes. Information can also be collected and stored in the same way for research. Further, for analysis and reporting, technology can be used. Not only quantitative data but also qualitative data can be analysed and there lies the role of computer and the different methods of data analysis methods and techniques. Moreover, in developmental type of research, different kinds of packages can be developed for raising the effectiveness of learning. There are many researches already conducted in this field i.e., development of programmed learning materials, computer assisted instruction, and computer assisted language learning packages.

With the facilities of INTERNET, Website, and INFLIBNET the researchers as well as a learner wanting to inquire or find out something that is happening elsewhere can have access to a large amount of information sitting at home. He can float his hypotheses, problems, and ideas and get them solved while at home. In this process, the research findings are not only disseminated but also the quality of research can be increased.

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**Check Your Progress**

Notes: a) Write your answers in the space given below.
       b) Compare your answers with the one given at the end of the unit.

3. What do you mean by hardware and software aspects of educational technology?
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4. What are the different applications of educational technology with which you are familiar?
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**4.6 EVOLUTION OF EDUCATIONAL TECHNOLOGY**

Human beings have the potential to create. This potential has enabled the people to solve problems and learn from their experiences. The ancient man learned to roll logs of wood, tried to communicate through verbal and non-verbal ways, evolved language and gradually then written and printed materials were developed. Later on, the technology of software based on psychology and sociology came into being. Now, we have mass learning, group learning, and individual learning in operation. In all these new ventures we have used many technologies. These technologies have evolved through the past decades of the nineteenth century. They can be placed in four phases as follows:

i) Audio-visual phase
ii) Cybernetic phase
iii) Psychology-Sociology based phase and
iv) Computer and Telecommunication phase

**4.6.1 Audio-visual Phase**

Before the 1950’s, the term audio-visual education was used (and not E.T.). There were various teaching aids like blackboard, maps, radio, films, etc. These were mainly media through which a teacher presented his messages. The materials developed were not systematically based on any psychological principles. Education was viewed primarily as a process of transmitting by a teacher, the messages which he considered important, to students. In this transmission, he used aids which highlighted the messages. In a sense, this tradition started with printing technology — books, maps, charts, etc. Although a good teacher in his
transactions with students, asked them questions etc.; and encouraged interaction with them, aids like books, radio or film were primarily non-interactive. This can be represented by the following figure.

![One-way Communication](image)

**Fig. 4.1: One-way Communication**

### 4.6.2 Cybernetic Phase

While steering a ship, the sailor needs to know in which direction his boat is sailing, how far the boat is from the either bank of the river/sea etc. In other words, he needs information about the process in relation to the goal to be achieved — the end result to be obtained. This requires “feedback”. The cybernetics tradition which lays emphasis on feedback is traced back to the Second World War where there was a need for a systematic communication and control system. Cybernetics has been defined as the comparative study of the human (or biological) control mechanism and electro-mechanical control systems such as computers. The word Kybernetes in Greek, means “steersman”, which emphasises the principle of feedback control. The feedback refers to a kind of reciprocal interaction between two or more events in which one activity generates a secondary action which, in turn redirects the primary action. The feedback system has three functions:

a) It generates movement of the system towards a target or in a defined path,

b) It compares the effect of this action with the true path and detects error, and

c) It utilises error signal to redirect the system. A simple form of the cybernetic model is presented in figure 4.2.

![Cybernetic Model](image)

**Fig. 4.2: Cybernetic Model**


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

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

This further led to a complex systems approach where each component of a system provides feedback to other components so that the totality — the system keeps on moving in a specified path towards a pre-determined goal.
Cybernetic principles have some implications for learning

a) The activity involved is geared to the learner's stage of growth — physical and cognitive.

b) The learner is given an opportunity to perceive meaningful relationships among the elements of the goal towards which he is working.

c) The learner is provided with some criterion for indicating to him specifically what progress he is making.

d) The learner is presented the activity both in verbal and non-verbal context in varied situations and practice conditions.

4.6.3 Psychology-Sociology Based Phase

This phase has a long history. It can be traced back to the learning theory given by Thorndike in 1913. Based on his theory, Pressey (1926) developed a teaching machine. It provided an automatic scoring device to the learners on immediate feedback basis. So, this was the first step towards the formulation of systematic learning. Subsequently, the theory of B.F. Skinner (1953) i.e., operant conditioning and the work of Norman A. Crowder opened new chapters in developing Programmed Learning Materials. Their main contribution was that human behaviour can be shaped. The following are the principles of operant conditioning:

1. Immediate reinforcement to student's response,
2. Gradual progression to establish complex repertoires, and
3. Revision or modification of the programme to fit the students.

In addition to the contributions by this behaviouristic psychology (Skinner et. al.) cognitive psychology has also thrown more light on how learning takes place. Piaget and Bruner, later day constructivist psychologists, have pointed out that a human individual is not only “taught” by external forces, but he also learns, constructs his own world — e.g. concept maps etc., organises his own learning, masters the environment around and changes/modifies his behaviour/steers his ship at his own initiative, etc.

Sociologists, particularly the School of Group Dynamics also added insights regarding how an individual learns in a group, through interaction with peers and others.

In brief, the social sciences — psychology, sociology, anthropology, etc. have also contributed a lot to understanding of the teaching-learning process and in turn influenced educational technology.

4.6.4 Computer and Telecommunication Phase

In the last decade, the world has been deluged with software technology which has been also used amply for education and training. Multimedia, E-mail, internet, intranet and website are used extensively today. There are telecommunication modes through which instructional materials can be given to students. There are many computer software packages developed for school children in many of the school subjects. These packages also have been used and proved to be effective in terms of time and level of students achievement. There are also several organisations established in different parts of the world for the development of software packages. For example, in India we have Audio-Visual Research Centres, Educational Media Research Centres and different Departments of Education and Educational Technology which have been developing software packages for the education of children. Many audio-visual programmes are also telecast by Delhi Doordarshan for school children. Many of our progressive schools are also developing educational software packages for children. School libraries also have such packages which are used by teachers and students for teaching and learning. These packages are based on immediate feedback principles which help students to learn effectively. In addition, many of these packages are interactive, that is, as in a live teacher-student transaction a student can also ask a question, do a project, revert back to a teacher/computer, make further inquiries/explore on his own, and thus learn from different sources more or less on his own (without the help of a live teacher). (More details about computers software development are given in Unit 11, Block 3).
Note that the evolution of educational technology has been presented in four phases for the sake of understanding it in a better way. But you may see that these phases do not have watertight compartments. The different phases are intermingled and can help each other to grow.

Check Your Progress
Notes: a) Write your answer in the space given below.
   b) Compare your answer with the one given at the end of the unit.

5. State the difference between the first phase (prior to 1950) and the fourth phase of Educational Technology evolution.

4.7 LET US SUM UP

In this unit, you have learned that educational technology is a science of techniques and methods by which educational goals can be realised. Educational technology, as you have learned, has two aspects i.e., hardware and software. Hardware technology is based on the principles of engineering and software technology is based on the principles of social sciences. In our educational system, there is a wide scope for educational technology i.e., to educate the masses, store historical information, collect large amount of information, use as alternative to hazardous, costly, or non-feasible experiments by simulation. It also provides us the facility of distance education methodology and research by manipulating large amounts of data. The evolution of educational technology can be seen in four phases viz., Audio-visual phase, Cybernetic phase, Psychology or Social Sciences phase, and Computer Software and modern telecommunication technology phase. In this process of evolution you learnt that many different disciplines of studies have played a great role.

4.8 UNIT-END ACTIVITIES

1. Visit a secondary school in your locality, meet the seniormost teacher (with more than 25 years of service) and ask him to tell you how educational technology has evolved in his school.

2. Find out from different subject teachers in a secondary school how they change their methods of teaching over the years.

4.9 POINTS FOR DISCUSSION

1. Looking into the evolution process of educational technology what can be its future?

2. What is the contribution of psychology towards the development of educational technology?

3. How is educational technology a science?
4.10 ANSWERS TO CHECK YOUR PROGRESS

1. Educational Technology is a science of techniques and methods by which educational goals can be achieved.

2. Technology of education deals with systematic application of the resources of scientific knowledge of the processes of learning that each individual has to pass through in order to acquire and use knowledge. Technology in education refers to the use of technological hardware in education.

3. Hardware aspect of educational technology refers to machine aspect of educational technology which includes tape recorder, computer, OHP, etc. Software aspect of educational technology includes audio/video cassettes, microfilm, slides, etc. while the former is based on engineering principles, the latter is based on psychological and sociological principles.

4. The applications of educational technology are in the following areas:
   i) mass education
   ii) historical information
   iii) costly and hazardous experiments
   iv) gaming and simulation
   v) distance education
   vi) collection, storing, retrieving of information
   vii) research

5. Educational technologies like blackboards, books, maps, films, etc. which were used before the 1950's during the first phase were non-interactive in nature, whereas educational technologies like computer, e-mail, internet which are used in the fourth phase of the evaluation of Educational Technology are interactive in nature.

4.11 SUGGESTED READINGS


