

Indira Gandhi National Open University
Staff Training and Research
Institute of Distance Education

Block**3****COSTING IN DISTANCE EDUCATION**

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MDE-417: Distance Education: Economic Perspective

(New Course in place of ES-317: Distance Education: Economic Perspective)

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MDE-417: Distance Education: Economic Perspective

Course Outline

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 - Unit 3 : Comparative Cost Analysis in Distance Teacher Education (*Alison Richardson*)
 - Unit 4 : The Costs and Costing of Networked Learning (*Greville Rumble*)
 - Unit 5 : A System-Level Comparison of Cost-Efficiency and Return on Investment Related to Online Course Delivery (*Thomas Ramage*)
 - Unit 6 : Activity-Based Costing Models for Alternative Modes of Delivering On-Line Courses (*Chris Garbett*)
 - Unit 7 : Private Cost of Education: A Comparative Study of Distance and Campus-based University Students in Nigeria (*Felix Olakulehin & Santosh Panda*)
 - Unit 8 : Costing of Distance Learning: A Study of the Indian Mega Open University (*Ashok Gaba, Santosh Panda & C.R.K. Murthy*)
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INTRODUCTION TO THE BLOCK

This third block of the course MDE-417 deals with cost analysis in distance education and networked/online learning. The first unit deals with various types of activities carried out in Distance Education (DE)/Online Learning (OLL), and, therefore, are treated as cost centres for distance education. Besides, the input and output considerations are discussed, and research on costing approaches in DE/OLL are briefly outlined.

The second unit deals with the cost structures in distance education; and various types of costs and factors affecting costing in DE/OLL are discussed. The fixed and variable costs, and average and marginal costs, are the ingredients toward cost calculation which is basically institutional cost and/or individual/private cost, expressed in terms of 'unit cost'. You may also refer to the third unit in Block 1 which deals in detail with educational costs. The study of cost structures shall equip you to appreciate the cost functions given in the third unit (based on which actual costing is done). We have also discussed the concept and application of economy of scale; and have cited costing of self-learning materials as an example. Various cost studies as cases have been presented in Block 4, to which these three units can be related to.

The final fourth unit is devoted to discussion, with research evidences, of cost of technology-enabled learning and costing online learning. Based on a clear understanding of the situation when an institution deploys online education and blended learning delivery, the costing framework as well the variables relating to costing of design and development, teaching-learning/delivery, administration, and overheads have been further elaborated. A brief on research on costing online learning has also been included.

We hope that the knowledge gained through the former two Blocks shall facilitate you to understand the contents of this third Block, as also the understanding of the contents of this third Block shall equip you to appreciate the cost case studies presented in Block 4, and the exhaustive available research studies on cost of DE and online learning compiled in Block 5.

UNIT 1 COST ANALYSIS OF DISTANCE EDUCATION

Structure

- 1.1 Introduction
- 1.2 Learning Objectives
- 1.3 Why Study Educational Costs
- 1.4 Types of Activities and Costing in Distance Education
- 1.5 Input and Output Considerations
 - 1.5.1 Resource allocation considerations and measurement of educational benefits
 - 1.5.2 Different categories of cost factors in distance education
- 1.6 Research on Various Costing Approaches
 - 1.6.1 Cost-effectiveness
 - 1.6.2 Cost-efficiency
- 1.7 Let Us Sum Up
- 1.8 Model Answers to Activities
- 1.9 Suggested Readings

1.1 INTRODUCTION

This is the first unit of this module on cost analysis of distance education. We look at various activities within distance education (DE) which constitute the cost centres and which are taken into consideration for calculating various costs in DE. Besides discussing various input and output considerations, we discuss research studies on costing approaches – cost-effectiveness and cost-efficiency – which shall provide a general understanding on how costing in DE centres around these approaches. With this general understanding, it will be easy to conceptualize cost structures and cost functions presented in the second and third units, and on costing technology-enabled learning discussed in the fourth unit.

1.2 LEARNING OBJECTIVES

After going this unit, you should be able to:

- define costing in distance education and describe the reasons for studying educational costs;
- list and describe various types of cost calculations in distance teaching-learning vis-à-vis the input-output considerations; and
- briefly analyse the available research on cost-effectiveness and cost-efficiency of distance education.

1.3 WHY STUDY EDUCATIONAL COSTS

An educational cost function expresses the relationship between the inputs and the outputs of education. An assessment of such a relationship lends perspective with regard to the quantity, the quality and the forms of inputs needed for producing one unit of output. These, in effect, determine the relationship between the average cost and the marginal cost, and also between the economies and diseconomies of scale. Such analyses help us gain an idea of the cost of education and the major factors that account for it, which are obviously of crucial importance from the point of view of the planning and management of an educational system.

The planners need to know where the money is coming from and where it is going since about 3.5% of the GNP is devoted to educational development in India. Such a large proportion of expenditure (which in order of priority, is next to the level of expenditure on national defence) necessitates for the planners to make a thorough analysis of educational costs, especially for the following purposes:

- i) to discover the possible imbalance, their extent, etc. in the allocation of educational resources to different sub-sectors of the educational system or to different regions of the country;
- ii) to identify the factors that are responsible for the rapid increase in expenditure or to examine the pattern of uses of funds for education; and
- iii) to identify the potential sources of funds not yet tapped for financing education.

The above purpose cannot be met without analysing such aspects of expenditure as the sources of the funds for education, the components of expenditure (like capital costs, recurring costs, and the unit costs by level and type of education), etc. The extent to which different types of costs are involved in realising various educational objectives can be explained through the simple cost models, which are generally referred to as cost functions. The specification of cost functions helps identify the degree of influence exercised by different factors which have a significant bearing on the development of educational programmes. The cost functions provide desirable perspectives with respect to both the pattern of distribution of financial resources for various educational purposes and the areas which require a close scrutiny for ensuring efficiency in the use of resources.

1.4 TYPES OF ACTIVITIES AND COSTING IN DISTANCE EDUCATION

We shall examine these aspects in the context of distance education in the second and third units. Before doing that, we need to examine the various activity-centres in the operation of the distance education system, which indicate various cost-centres, i.e. activities or group of activities, which constitute a portion of the total cost. These activities

also influence the fixed and variable costs, as well as the average and marginal costs. In the following section, we discuss these activity centres in the distance education system, followed by input-output considerations, and research outcomes on approaches followed to study cost-effectiveness and cost-efficiency in distance education. At this stage, you may recall or refer to these terms in the context of educational costing given in Unit 2 in Block 1.

Within the operation of a distance education institution/open university, the following major activities are undertaken:

- Programme/course design.
- Programme/course development.
- Programme/course delivery.
- Programme/course evaluation.

Therefore, these four major activities (which are briefed as follows) constitute the four major cost-centres in distance education. The types and extent of expenditure involved in these four activity centres depend on the approach or mechanism followed by education institution. Generally, the following activities and expenditure are performed.

Programme/course design: The design of any new academic programme starts with conducting a need survey for such a new programme or new course. The survey may cover:

- analysis of existing human resource requirement reports,
- demand from the public or prospective students,
- reports of national or provincial governments,
- national need for gross enrolment ratio (GER), results of academic research and analysis,
- requirements of government departments or industries or national and international organizations,
- requirement of particular communities or groups of people under democratization of education, and
- requirement by the community for awareness and lifestyle changes. The positive outcome of the needs analysis leads to preparation of a concept note by the concerned faculty or programme coordinator.

The concept note details out the programme title, objectives, target groups, entry requirements, availability of experts for development of learning resources (print, audio, video, digital resources, and online resources), the modality of programme development and delivery, possible sources of funding for the development of such a programme, and the fee to be charged from students. All the above activities require faculty time and various expenses including faculty salary and honorarium paid to other experts.

Programme/course development: This involves actual development of detailed programme handbook, course modules and units, credit hours for each, technology (ICT) resources, student

activities and practicum, student assignments, student programme guide, among others. All these activities also require time and money.

The amount of time and the extent of expenditure depend on the modality/mechanism followed in developing the learning resources. Various course development models are available (which can be further consulted) (Panda & Garg, 2006), as also on the mechanism of media mix – supplementary, complementary, and integrated (Panda, 2006).

Programme/course delivery: Once the programme (or the course, as part of any certificate, diploma, or degree programme) gets fully developed, the next step is to implement the programme, or in other words, deliver the programme. This activity starts with advertisement for admission in the programme, student admission, material printing and duplication of audio-video (A/V) as per number of students admitted, material dispatch to students, other related communications to students, appointment of counselors (and if needed, opening up of new study centres), conduct of counselling/tutoring sessions and practicum (labs, computer centres, work or activity centres, internships, practice teaching, etc.), evaluation of student assignments, conduct of examinations, etc. There may also be bulk sms communication to students, online communication, additional web-based online learner support, call centre support, among others. These activities require expenditures which are taken into consideration for calculation of costs.

Programme/course evaluation: Distance teaching institutions are required to maintain their programmes over a period of time, after which the programmes need through evaluation and revision. Most institutions undertake this activity once in every five years of operation of a programme. Till a programme is completely evaluated, it is 'maintained' across each semester or year. This involves maintenance of student record, counselor record, credit transfer and re-registration, feedback from students/tutors/experts which lead to minor revision of the programme or the course(s) each semester or each year. The expenses involved in these activities also contribute to calculation of cost of the programme or the unit cost.

1.5 INPUT AND OUTPUT CONSIDERATIONS

Comparisons of inputs and outputs of education facilitate the decision-making process, especially with respect to the allocation of resources. Like firms, educational institutions also transform inputs into outputs. A set of inputs like teachers, stationery, instructional materials, furniture, building etc. are combined in such a way as to produce the output, i.e., graduates with new knowledge and higher cognitive ability. The use of inputs entails definite cost in terms of both monetary expenditure and alternative investment opportunities that must be sacrificed to enable this transformation to occur. While on the one hand the costs of some of the inputs like expenditure on teachers' salaries are measured by monetary outlays, on the other, the

costs of some other inputs like capital costs of durable assets and the forgone earnings of the students are imputed. The value of inputs in alternative uses is, estimated thus.

1.5.1 Resource allocation considerations and measurement of educational benefits

As educational services are, to a large extent, treated as a social activity rather than an economic one, the allocation of resources is not determined by the market forces of supply and demand for education. The planners, however, need to know the costs (and the benefits as well) involved in producing different levels and combinations of educational outputs. In effect, the perceived knowledge of costs and benefits, which is gained from relevant comparisons of inputs and outputs, determines the ultimate size of the educational benefit.

The costs and benefits of education are, however, not easily susceptible to measurement owing largely to conceptual and statistical problems, as a result of which the agreement on the benefits of education is hard to arrive at. This, therefore, distorts the educational decisions.

Cost-effectiveness and cost-benefit analysis

The relationship between inputs and outputs can be analysed by using techniques of productivity measurements like cost-effectiveness analysis which, in essence, compares the cost of the inputs and the achievement of objectives, measured in terms of examination results or some other measures of output and quality. There are two ways of undertaking cost-effectiveness analysis. One way is to compare the cost of two different institutions or educational methods: for instance, distance teaching and conventional face-to face teaching. If the two types of education produce the same level of output, then the most cost-effective is the one which achieves this output at the least cost. Alternatively, if the output varies, then cost-effectiveness analysis can show which of the two alternatives achieves the higher level of output for a given cost. In both the cases, it is necessary to measure both costs and effectiveness in quantitative as well as qualitative terms.

Cost-benefit analysis (given in Unit 3 of Block 1) is yet another way of analysing the relationship between inputs and outputs. In order to use the techniques of cost-benefit analysis, it is necessary to measure both the costs and the benefits *in economic or financial terms*. On the other hand, in cost-effectiveness analysis, the outputs of education can be measured in terms of scores in achievement tests, examination results, or some other measures of educational quality.

1.5.2 Different categories of cost factors in distance education

In essence, the study of the relationship between the inputs and outputs of education is analogous to the concept of production function in economic theory. The processes and forms of production in distance education are comparable to those of the manufacturing

industry. Accordingly, the method of imparting knowledge, skills and attitude at a distance is regarded as an industrialised form of teaching and learning. In this system of education, a teacher teaches at a distance through the use of a variety of media, with the production of high quality teaching materials, which make it possible to instruct a large number of students spread over a wide geographical area. Obviously, this, as in an industrial enterprise, involves adherence to certain basic principles of planning and management of mass production, mechanisation, rationalisation of the decision-making process, standardisation of the products, etc. Therefore, the inputs and the processes of utilisation of those inputs in distance education differ considerably from the conventional education system, though the ultimate output remains the same in both the systems. The differences in inputs bring in new categories of factors that influence the costs of distance education.

Activity 1.1

Describe, in about 15 lines, how the inputs and outputs in distance education differ from those in conventional education?

Notes: i) Space is given below for writing your answer.
ii) Compare your answer with that given at the end of the Unit.

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1.6 RESEARCH ON VARIOUS COSTING APPROACHES

Though there are a variety of costing approaches used in costing studies, generally two important approaches are considered as foundational and essential – *cost-effectiveness* and *cost-efficiency*. In distance education and online learning, these two approaches are also used for decision-making on programmes to be offered, approaches to be adopted, for teaching-learning, and institutional programme

delivery strategies including cross-border-delivery. Research undertaken on these two approaches within distance education is analysed briefly in the following sub-sections.

1.6.1 Cost-effectiveness

Cost-effectiveness refers to achievement of pre-stipulated objectives within the pre-given budget, within the defined level of quality. Generally, the output is expressed in quantitative terms, though not necessary in monetary terms. The quality level of output is expressed in terms of any score or grade or rank, for instance, percentage of student pass-out within a cohort, and the percentage of students securing distinction, first division, simple pass, and so on. Rumble (1999) discusses various types of studies on cost-effectiveness, which include the following:

- Study of short-term outputs (like, student scores and grades) and long-term outputs (like, more number of and quality courses developed by faculty with additional workshops or faculty development programmes; or study of destination of graduates after completion of the programme of study).
- Study of the effect of the use of educational technology (i.e. ICT and/or online learning) in reduction in programme cost *versus* the quality of student learning. There are differing views and research studies on either increase or decrease of the quality of student learning experiences due to use of technology. It is generally believed that even if technology does not make much difference to student learning, it surely affects attitude, behaviour and time management.
- Studies that attempted (and found difficult) to isolate the effects of multiple variables (for example, multiple learning resources, use of multiple ICTs) attributed to the output. Further, there have been difficulties in determining what is a good effect and what is bad.

1.6.2 Cost-efficiency

Cost-efficiency refers to either achievement of the stipulated objectives with lower than the given budget/cost, or cost of an alternative strategy of implementation, which could indicate lower cost or higher output. Comparative studies on alternatives (i.e. alternative systems of programme delivery, for instance) take into consideration the quality of education and quality of graduates for both the alternatives as equivalent or equal. When compared with cost-effectiveness, you may realize that it is possible that one can be cost-effective without being cost-efficient, but the reverse is not possible – i.e. to be cost-efficient, one needs to be cost-effective (Rumble, 1986).

Rumble (1999) reviewed a number of studies on cost-efficiency of distance education and technology-enabled learning (see also Unit 4 of this Block), which suggests the following:

- The UNESCO-sponsored studies of the later part of the twentieth-century suggested that distance education was less costly with similar or better results than the traditional modes of education. The main reason was that a variety of media replaced the full-time teachers and thereby reduced the labour cost.
- In case of teacher education, distance education was found cheaper than any alternative. Rumble writes: “Overall, the evidence is sufficiently strong to support claims that distance education can be, **under the right conditions**, more cost-efficient than traditional classroom-based education” (1999, p.126).
- The factors which contributed to cost-efficiency included large student enrolment, number of courses in the basket, number of years of course offer before revision, media choice and media-mix, the extent of overhead costs, and full-time versus contractual staff.

Activity 1.2

Distinguish between cost-effectiveness and cost-efficiency, and briefly suggest the research findings of studies conducted within the distance education system. Write in about 20 lines.

- Notes:** i) Space is given below for writing your answer
ii) Compare your answer with that given at the end of the Unit.

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1.7 LET US SUM UP

We discussed in this Unit that the study of educational costs contributes to be considered decision-making in the allocation of scarce resources to different sectors of education and activities within education, in the identification of factors contributing to increase or decrease in educational cost, and in tapping sources for additional resource mobilization. In the distance education system, which involves major activities relating to programme design, development, delivery, and evaluation, study of both cost-effectiveness and cost-efficiency assume importance to establish right balance between inputs and outputs, to locate alternative strategies and modes of delivery, to decide upon the right media-mix, and ascertain cost savings as well as sources of additional funding.

1.8 MODEL ANSWERS TO ACTIVITIES

Activity 1.1

In conventional face-to-face education, inputs like the teacher, face-to-face teaching, library facilities, buildings and furniture, teachers' salaries, etc. are taken into consideration to find out their relationship with output, i.e., the graduates. The situation is altogether different in distance education settings where multi-media are used to impart instruction at a distance. Therefore, the inputs like the print materials, audio-video materials, etc., are themselves considered as outputs. These along with other inputs like course design and development, production and distribution of materials, academic-counselling support, instruction through assignments, cost of infrastructure at the headquarters and regional and study centres, salaries paid to the functionaries, etc. and the way these inputs are put to use, which is different from those of conventional education.

Activity 1.2

While cost-effectiveness is concerned with achievement of the pre-stipulated goals and learning outcomes within the given cost and level of quality, cost-efficiency indicates alternative strategies of implementation with lower costs. Research studies on cost-effectiveness of distance education indicate focus on studying both short term and long term outputs, effect of the use of information and communication technology (ICT), isolation of factors in an operation of multiple resources and delivery strategies, among others. In the case of cost-efficiency studies, distance education was found to be cheaper than campus-based education due to large scale use of mass media replacing the cost-intensive teachers, though in the context of appropriate conditions (i.e. balancing the right mix of resources, teaching-learning strategies, media-mix, and learner support).

1.9 SUGGESTED READINGS

Bramble, W.J. & Panda, S. (eds.)(2008). *Economics of Distance and Online Learning: theory, practice and research*. New York: Routledge.

Panda, S. (2006). *Handbook 7: Media and Technology in Distance Education*. New Delhi: STRIDE, IGNOU.

Panda, S. & Garg, S. (2006). Models of course design and development. In S. Garg et al. (eds.) *Four Decades of Distance Education in India*. New Delhi: Viva Books.

Rumble, G. (1999) Cost-analysis of distance learning. *Performance Improvement Quarterly*, 12(2), 122-137.

Rumble, G. (1986). The economic perspective. In G. Rumble (ed.), *The Planning and Management of Distance Education*. London: Croom Helm.



UNIT 2 COST STRUCTURES IN DISTANCE EDUCATION

Structure

- 2.1 Introduction
- 2.2 Learning Objectives
- 2.3 Cost Types
 - 2.3.1 Fixed and Variable Costs
 - 2.3.2 Average and Marginal Costs
 - 2.3.3 Cost Sources
- 2.4 Factors Affecting the Costs of Distance Education
 - 2.4.1 Factors in public expenditure
 - 2.4.2 Media choice and costs in distance education
 - 2.4.3 Other factors affecting distance education
- 2.5 Let Us Sum Up
- 2.6 Model Answers to Activities
- 2.7 Suggested Readings

2.1 INTRODUCTION

You have been given conceptual clarifications on various educational costs in Unit 3, Block 1 of this course, as also in the preceding unit of this Block. In the present unit, we have brought in those very cost concepts to describe their application in distance education.

Based on the brief discussion on the intentions behind the study of educational costs and a brief description on the input-output considerations in distance education as given in the preceding unit, we proceed to describe and differentiate a few important costs as applied in distance education. We will talk about the concept of 'economies of scale' in the next unit, which is very crucial in the cost estimation of any distance education institution (DEI). Some of the cost concepts often used in distance education like private cost and unit cost will also be discussed in the next unit. However, to appreciate the actual calculation of costs, it is essential to reflect upon the important factors which generally influence the cost of distance education, with specific reference to electronic and digital media.

2.2 LEARNING OBJECTIVES

After going through this Unit, you should be able to:

- describe and differentiate between a few cost types used in distance education; and
- describe various cost sources, and important factors which affect the cost of distance education generally.

2.3 COST TYPES

The different definitions of costs used by cost analysts have been borrowed from two sources:

- i) from accountancy: for example, labour cost, material cost, capital cost, operating cost, direct cost, indirect cost, etc.; and
- ii) from economic theory: for example, fixed and variable costs, average and marginal costs, total costs, etc.

Let us concentrate on the cost types of the second category noted under item ii) above, which have greater relevance to both the systems – face-to-face or conventional education, and distance education. [At this stage, you may revisit Unit 3 of Block 1 on various types of educational costs.]

2.3.1 Fixed and variable costs

In treating the educational sector (more specifically the distance education sector) as an industrialized system of operation, the costs can be broadly divided into fixed and variable costs. Those costs that change with the activity or production rates are called **variable costs**, and those, which remain unchanged in spite of changes in production rates, are identified as **fixed costs**. In education, construction of a building usually represents a fixed cost, while the maintenance of the building is a variable cost, which depends upon the number of classrooms, laboratories and square footage used. In other words, the fixed costs are those, which are incurred by the institution for all the members of the institution, both teaching and non-teaching staff, and partly pertain to one-time investments. They include the costs of land, building, hospital, laboratory, library, hostels, gas plant, installation of electricity, telephone, etc. It is very difficult to assign a fixed proportion of the cost of these items to any group the institution is concerned with. These costs are, therefore, treated as fixed costs.

All the non-recurring expenditure in an institution can be treated as the 'fixed' costs, as they are independent of the scale of operational activity. For example, if a lecture is not attended, the fixed cost of the lecture will not be affected at all. The imparting of knowledge through direct broadcast media in distance education is a striking case of an instructional method which incurs only the fixed costs. Whether the broadcast is watched by a million students or none at all does not affect the cost of media used for that academic programme. In brief, the fixed costs remain constant in an absolute amount, or, in other words, they do not vary continuously over a wide range or volume of output.

On the other hand, variable cost refers to that segment of costs, which is determined by the variable factors involved in the process; for example, the number of students, the salaries of the teachers and non-teaching and technical staff, the cost of stationery and postage, printing of prospectus and course materials, library books, etc. The variable costs in education are those which are referred to as recurring costs. The teacher-student ratio, the capacity of the building, the nature of the courses, etc. generally determine the variable costs. It

could, thus, be said that the variable costs refer to that segment of the costs, which is affected by the number of students and other related factors, which further influence the volume of output. If a change in the volume of output brings about a change in the amount of a particular cost element, then it is a variable cost. In a distance education system, these costs are basically related to specific activities and are those, which are incurred on course development and production, tutoring, counselling, material distribution, etc., where, in principle, each item or activity involves a particular amount of cost. While the costs involved in course design and development could be fixed costs (since the development of materials does not depend on how many students will get admitted to the programme later), printing and distribution costs of those materials shall be treated as variable costs (since these depend exactly on the number of students admitted, and will vary from semester to semester, or year to year). Similar is the case when the appointment of counselors depends on number of students allotted to a study centre, which is variable cost, where as the costs involved in conducting tutorials are fixed (since the tutor has to present lectures etc. irrespective of number of students who attend the counselling/tutorial session).

You may note another point here: whether the costs are fixed or variable also depends on the time scale. In the short run, the costs of teachers as well as of buildings may be fixed, although the costs of the number of books, stationery and other materials are variable with the number of the students. For a short period, the course production costs may be treated as fixed but they become variable after the passage of a certain period of time and with an increase in the number of students. Obviously, the distinction made between the fixed and variable costs is not absolute, as the fixed costs may apply to an operation of a size that may vary considerably.

2.3.2 Average and marginal costs

Cost analysis may be concerned either with total costs of education, or with the unit costs, which measure the costs of educating one student. There are two different ways of measuring the unit costs. If the total expenditure or cost is divided by the total number of students enrolled in an educational institution, we get the **average cost per student**. Likewise, if the total expenditure is divided by the number of the graduates, it gives us the **average cost per graduate**.

Moreover, it is also necessary to measure the additional costs incurred when one additional student is enrolled. The additional cost attributable to one extra student is called the **marginal cost**, or the incremental cost. It is measured by the increase in the total cost, which occurs as a result of increased enrolment brought about by addition of one unit or student or more.

The relationship between average and marginal costs varies between different institutions, and it depends on the form of the cost function, i.e., the relationship between the cost and unit size. With the increase in the number of the students enrolled in an institution, the total cost rises, but in this situation the behaviour of the average and marginal costs may be different. The reason why the average and marginal costs

vary in different circumstances is that in educational institutions, some costs are fixed, while others are variable with respect to the size or number of the units, i.e. students.

To clarify the above point, let us take an example in which the figures on costs and students are hypothetical. Say, for instance, there are 10 students attached to a study centre and their attendance at the study centre in a particular academic session is compulsory. The study centre incurred, let us assume, a total cost of Rs.5000 per year, out of which Rs.3000 was fixed cost (FC) and Rs.2000 was variable cost (VC). The average total cost (ATC) would, then be Rs.500, average fixed cost (AFC) Rs.300, and average variable cost (AVC) Rs.200 per student/unit. Let us further assume that the study centre incurs an additional total cost of Rs.300 (i.e. marginal cost) for extending the facility to an additional student. In that case, the TC increases to Rs.5300 out of which Rs.3000 is FC and Rs.2300 is VC. However, in this situation of an additional enrolment, the average costs would show certain changes. Now the AFC would be Rs.273, while the AVC would be Rs.209, and the ATC Rs.482. You will notice from the above cost calculation that while the ATC and AFC declined, the AVC increased, though the marginal cost (MC) of an additional enrolment in the study centre was Rs.300.

The way in which the average and marginal costs change (as the total number of students increases) depends on whether a major chunk of the costs is fixed or variable, and whether all resources are fully utilised or there is spare capacity to increase the number of the students without incurring additional fixed costs.

2.3.3 Cost sources

All the components of the fixed and variable costs, as discussed above could be taken as the sources of costs. In other words, all the items of expenditure, which are related to various educational activities could be termed as sources, which involve or generate the educational costs. You may have by now visualized the macro as well as micro picture on the various cost-centres (as discussed in the preceding unit). Further, to have considered decision-making in respect of costing in distance education, you need to consider the various factors which influence the cost of distance education (as discussed in section 2.4 below).

Activity 2.1

Distinguish between fixed and variable costs in distance education with the help of an example. Write within 150 words

Notes: i) Space is given below for writing your answer.
ii) Compare your answer with that given at the end of the Unit.

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2.4 FACTORS AFFECTING THE COSTS OF DISTANCE EDUCATION

2.4.1 Factors in public expenditure

Educational efforts are commonly measured in terms of public educational expenditure as a percentage of national income (that is, in terms of a national indicator). Two sets of factors appear to be relevant in explaining the level of total public educational expenditure and its changes over time.

- i) The first set of factors relates to the supply of education and the amount of funds available to the government for financing education. The determinants of educational supply and budgets are quite complex. They include factors, such as, the rate of inflation, the range of competing demands for other public services, the rate of growth of the national economy, the diversity of tax bases for education, the sensitivity of educational revenue to changes in the national income, the impact of foreign trade, and the availability of foreign aid to education.
- ii) The second set of factors relate to the demand for education. They include the growth in population and its age distribution, the importance of education for social mobility and national development, the choice and development of technology for economic production, the level of coverage of education to diverse segments of the population, and the direct and indirect impact of national and international development policies.

These two sets of factors are external to education in the sense that they lie outside the control of the educational administrators and policy makers. Studies have established that national income and enrolment ratio are the two major important determinants of public educational expenditure. In all educational systems, public educational expenditure is dominated by personnel costs, especially teacher salaries. The ratio of personnel costs to non-personnel costs is high at all levels of education, and this obviously reflects the labour-intensive technology of educational production.

Also, given the salary increase associated with automatic promotion in the pay structure of the teachers, there is a built-in tendency for the teacher costs to rise over time. A high percentage of the budget is, therefore, committed to the teacher costs. Like other developing countries, this is true of India too. Due to the budgetary constraints and pressures from the teachers for higher salaries, there have often been shifts in the allocation of resources from non-salary items such as books, equipment and other teaching aids, to the salary items. Thus, the non-salary expenditure as a proportion of total public expenditure tends to decrease with the passage of time, affecting the optimum mix of inputs in educational production. This is precisely what has been observed for the relevant data pertaining to higher education in India.

In addition to the factors discussed above, the choice of media and other factors also affect costs in distance education. We shall elaborate on this point in two sub-sections below.

2.4.2 Media choice and costs in distance education

As teaching at a distance entails independence of both time and place of delivery, the instructional media used in distance education do not require the students to study at a fixed time or place. Since distance education maximises accessibility to educational opportunities, a variety of media, like printed material, radio, TV, web-based media etc., are used for imparting instruction. The costs of teaching through different media however vary, mainly due to the influence of factors like fixed and variable costs, the composition of which significantly varies for different media. Each type of medium of instruction has some advantage over others in respect of costs, coverage, effectiveness, etc., but these educational media cannot be perfect substitutes for one another. For this reason, a mix of different media is chosen for carrying out the teaching-learning process. The decision about the choice of a mix of media is not so easy, as the implications of a number of factors, especially relating to planning and management of resources, are required to be thoroughly examined so as to ensure that the expected benefits that accrue are more than the estimated costs of the media-based system of distance education. As may be expected, the decision about the best selection of a mix of media would differ from system to system.

These factors, which may be of regional or local importance, may crucially affect even rational decisions based solely on an analysis of costs and benefits. For instance, in a small densely populated and relatively prosperous country, which has more or less full television coverage and a comparatively high percentage of the population owns television sets, television has tremendous potential for education and development. As against this, in a large sparsely populated country, where the terrain is difficult and where the population is scattered, mainly illiterate and very poor, educational radio would appear to offer more than educational television. In some other situations, where radio and TV are not intensively used for different reasons, printed materials could be used for imparting knowledge, as it would then be possible for the learners to learn at their own pace and convenience. With the development of the semantic web, given that there is greater access and availability of broad band, web-based online and blended learning may be found more suitable (provided the teachers and students are comfortable in using the online technology). This autonomy is important, especially in teaching-learning situations where the entry-level capabilities of learners are not uniform. For such target groups, an imaginative use of the visual aid would work more effectively than the static printed study units. Conversely, a well structured and stimulating written unit would be more effective than reading out notes in the classroom by a teacher.

It is not possible, therefore, to say as to which educational media is most suitable to all the situations described above. Even if decisions are made completely on the basis of cost-benefit analysis, the

decisions to choose certain media will always be influenced by socio-cultural, political and administrative factors; and the pressures of these factors on local administrations are just as rational as economic analysis of costs and benefits. Any attempt to make a rational choice of media must incorporate all these influences, and indeed they are sometimes highly relevant even to the cost-benefit analysis. In order to make such rational decisions as would maximise the social objectives of educational development, the following aspects should be taken into consideration. You may like to think of other micro factors, which are related more individualized choices and abilities.

- i) It is necessary to identify the media to which the distance learners would have access. This involves checking on the infrastructure data, and, where necessary, establishing the potential learners' familiarity with and experience of learning from the media available to them, as well as their attitudes towards the chosen medium of instruction.
- ii) It is also necessary to ascertain what level of resources would be available for this project. Even if the learners can easily have access to the television and also it is used by them as a learning resource, there is no guarantee that the distance teaching institution would have access to production and broadcasting facilities and, more importantly, to the trained and skilled staff.

In brief, the choice of a mix of media, though very difficult, is indeed very crucial for promoting the distance teaching-learning process. In making a choice about a medium or a set of media of education, other socio-cultural and political objectives of imparting education are also taken into consideration, besides the economic costs.

Here we need to emphasise that the above details are considerations, which follow the primary consideration of the academic relevance of the choice of particular media in distance education.

Data on Indian distance education costs show that for correspondence education only using the postal delivery system, distribution of costs on salary and non-salary items was in the ratio of 53% and 47% respectively in 1985-86. For media-based distance education system, the observations made by Eicher *et al.* (1982) are noteworthy: that the design and production costs are generally much higher for television than for radio, although they vary considerably with geographical coverage; however, the fixed costs can be lowered significantly, if already existing broadcasting installations are used. On the other hand, in the case of distance education at the school level in India, it is found that for distance education using postal delivery and media mix, distribution of costs on salary and non-salary items was in the ratio of 19% and 81% respectively in 1995-96 (Gaba, 1997).

Production costs are particularly high for film, whatever the size of the system. They are relatively higher for television, but economies of scale are rapidly achieved as the audience-size increases. Production cost is low in the case of radio transmission and duplication costs are very high for the video systems. Unit costs for the open-circuit television transmission are high for audience sizes below 200,000, but

thereafter these drop rapidly and then rise slightly from 1 million upwards. Unit costs for the radio transmission are moderate for 100,000 students, and very low above that number. Generally speaking, the variable cost drops very quickly with the size of the system. However, the variable programme costs of television are always much higher than those of the radio. The media giving the greatest potential economies of scale are television via satellite, open circuit television, closed circuit television, and radio (and, may be, online education as discussed in Unit 4 of this block). The media giving the least, or no economies of scale, are the language laboratories, computer-based teaching, and films. The media for which the unit cost increases with the magnitude of the project are films and video systems, the cost of which quickly becomes prohibitive because of duplication problems.

As a general rule, small media (like the radio), requiring simple and inexpensive equipment such as slide projectors and tape recorders, offer a greater cost advantage than the big media (such as the television and computer-based instruction) where small audiences are concerned; but their relative importance diminishes subsequently. The radio, however, keeps a relative advantage over the big media whatever the audience size.

What appears to be evident from the foregoing details is that the cost of distance education depends on the extent of the utilisation of resources, the nature of technology used, the size of enrolment, and the number of courses offered. In some cases, there is no alternative. For instance, in the case of providing in-service teacher training to a large number of untrained teachers, distance education appears to be the only viable method. Under such circumstances, distance teaching methods are definitely cheaper than their conventional alternatives.

2.4.3 Other factors affecting distance education

As mentioned above, there are other factors, other than the media used, which affect the cost of distance education. We have discussed in Unit 1 that the offer of distance education programmes goes through four stages, i.e. programme design, development, delivery, and evaluation. There are factors associated with one or more of the above four stages, which affect the cost of distance education. Rumble (1997) has elaborated such factors which are applicable, in variation, in contexts of both face-to-face and distance education. These are briefly enumerated as follows:

- If an institution decides to use the existing materials as wrap-around course materials, this will drastically reduce the cost. Conversely, if all the course materials are developed afresh, this will drastically increase the total and unit costs. On the other hand, keeping in view contemporary developments, use of zero-cost open-text books and open educational resources (OER) will reduce the cost to almost zero.
- The working practices and decisions made thereof also affect the cost. If, in an institution, most or all of the office operation is automated, thereby reducing the human (labour) cost, the total

and unit costs will get reduced. Daniel (1996) also suggests that a distance education institution can reap the benefit of economy of scale if its enrolment crosses 100 thousand.

- The process or model followed in course design and development as also the number of courses offered for students to choose only a few affect the costs too. If course design, writing, editing etc., are done in a workshop context (without following writing and editing at a distance) and if all such activities are undertaken by the same expert (instead of specialized experts for different tasks), this will reduce the costs too.
- Learner support service is a major cost centre in distance education, which includes tutoring/counseling at study centres, other supports, lab and internship activities – all of these affect the cost of distance education. Reduction of the people-based operations and increasing technology-based operations will drastically reduce the cost.

Activity 2.2

Which of the following statements are true?

Tick (✓) mark such statements. Check your answer with the answer given at the end of the Unit.

- For an audience size of 200 thousand unit cost of transmission through radio will be very high. ()
- Both the production costs and variable costs are higher in the case of TV transmission as compared to that of the radio broadcast. ()
- The unit cost for TV transmission for an audience of more than one million is high. ()
- High economies of scale can be achieved if TV transmission is made via satellite. ()
- Radio broadcasts work out to be costlier than television telecasts if the audience is large. ()

2.5 LET US SUM UP

In this Unit, we presented some details about the importance of the study of educational costs from the point of view of determining average and marginal costs and of allocating resources to different heads. The items of expenditure in distance education differ significantly from those used in the conventional system of education, and depend on inputs like teacher, self-instructional print materials, audio-video and other technology-based materials, academic-counselling, regional and study centres, teaching at-a-distance, and so on. This, along with the processes involved in teaching-learning at a distance, give rise to a new input-output relationship and changing interpretations of costs in distance education.

While talking about cost, we noted that in distance education, initially, fixed cost increases; and instead of teachers' salary taking a large amount of variable costs (as happens in conventional education),

material development-production-distribution do so. We also touched upon the notions of average cost and marginal cost, and noted that both could be reduced by increasing the enrolment size and decreasing the use of cost-intensive electronic media so that economies of scale are achieved. We shall examine if the use of contemporary ICT developments, more particularly web-based education, will reduce the cost of distance education in the fourth Unit.

2.6 MODEL ANSWERS TO ACTIVITIES

Activity 2.1

Fixed costs in distance education are fixed irrespective of the number of students enrolled. For example, expenses incurred on study centres, design and development point and digital learning resources, establishment of computer and other labs, etc. are fixed costs. Whereas, expenses incurred on material printing/duplicating and destruction, counseling sessions, evaluation of assignments, lab practical sessions, etc., are variable costs and depend on the number of students enrolled. The average fixed cost will decrease with additional student enrolment, whereas the average variable cost will increase with increase in enrolment of additional students.

Activity 2.2

b, c and d are true.

If you have ticked only two or one or the above, we would suggest that you should read this section again when you are in a refreshed frame of mind! It is however quite natural to get misled, when dealing with such huge numbers.

2.7 SUGGESTED READINGS

- Bramble, W.J. & Panda, S. (eds.). *Economics of Distance and Online Learning*. New York: Routledge.
- Daniel, J.S. (1996). *Mega-Universities and Knowledge Media: Technology Strategies for Higher Education*. London: Kogan Page.
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- Gaba, A. (1997). Is open schooling in India really cost-effective? In M. Mukhopadhyay and M.Parhar (eds.), *Open and Distance Learning*. New Delhi: Jawahar Publication.
- Rumble, G. (2008). Economic models of distance education. In T. Evans, et al. (eds.), *Inteinational Handbook of Distance Education*. Bingley: Emerald.
- Rumble, G. (1997). *The Costs and Economics of Open and Distance Learning*. London: Kogan Page.

UNIT 3 COST FUNCTIONS IN DISTANCE EDUCATION

Structure

- 3.1 Introduction
- 3.2 Learning Objectives
- 3.3 Cost Functions
- 3.4 Economies of Scale
- 3.5 Cost Estimation
 - 3.5.1 Which costs to look for and why
 - 3.5.2 Classification and calculation of educational costs
 - 3.5.3 Unit cost of education and its application
- 3.6 Costing Learning Resources
- 3.7 Let Us Sum Up
- 3.8 Model Answers to Activities
- 3.9 Suggested Readings

3.1 INTRODUCTION

At this stage, you may like to revisit costing in education, including cost functions, given in Unit 3 of Block 1; and relate them to what you are going to study in this unit. The context here is distance education and the cost functions have been discussed in relation to distance education too. We have also discussed unit cost in cost estimation, as also how to achieve economy of scale, i.e. low level of cost while still increasing the volume of operation or increasing student enrolment. At the end of the unit, we have discussed how to do costing of learning resources or self-learning printed materials as an example of costing in distance education. Based on what you study in these units 1-3, we shall discuss in detail costing of technology enabled learning and online learning in Unit 4 of this Block.

3.2 LEARNING OBJECTIVES

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

- describe various factors involved in calculating unit cost in distance education;
- explain various cost functions in distance education from an operational point of view; and
- describe costing of self-learning material in print, as an example of costing in distance education.

3.3 COST FUNCTIONS

As you have seen in Unit 2, the total cost of an educational enterprise is made up of both fixed and variable costs. The fixed costs do not vary continuously in relation to changes in the volume of activities, although they may change if there are very significant changes in the scale of activities. The variable costs tend to increase or decrease directly with fluctuations in the scale of activity. Traditionally, most costs in the conventional educational institutions are treated as variable costs, which are directly related to the number of students. And, these variable costs largely determine the total cost of production function of education by substituting a range of media for the teachers as well as students in the context of distance education. This, therefore, changes the nature and form of the cost functions in distance education.

In distance education, very significant costs are incurred in the preparation of the learning materials like printed texts, television and radio broadcast programmes, video and audio materials, computer-based instructional programmes, practicum handbooks and workbooks, assignments, and so on. The expenditure on these items is incurred before the students enter the system and irrespective of the number of the students likely to be enrolled. The development and production costs of the learning materials can only be justified in economic terms if, at a later stage, there are sufficient numbers of students enrolled in the system to make the investment economically viable.

Let us discuss now the various cost functions in distance education, which will help us calculate the costs of distance teaching-learning and, more specifically, the unit cost of education.

Cost function: type 1

A simple form of cost function that may be derived for application in distance educational system is:

$$\boxed{TC = F + VN} \quad \dots\dots\dots (1)$$

Where,

TC = Total cost

F = Fixed costs

V = Variable costs per unit of output (N)

N = Number of units of output

(e.g., students/student hours, etc.)

Where the total cost function is observed to be linear (i.e., direct), the average cost (AC) is obtained simply by dividing the fixed cost by output (N) and adding to it the variable cost (V). Thus,

$$\boxed{AC = F/N + V} \quad \dots\dots\dots (2)$$

Sometimes, the marginal cost is also denoted by V.

Cost function: type 2

The two major factors which determine the costs of distance education are the number of students and the number of courses in an educational programme. The functional form of the equation for the total cost may now be rewritten as:

$$\boxed{TC = a + bx + cy} \quad \dots\dots\dots (3)$$

Where,

- TC = Total cost
- a = Fixed costs
- b = Average cost per course
- c = Average cost per student
- x = Number of courses
- y = Number of students

The values of b and c can be obtained by dividing the total costs allocated to the courses and the students by the actual number of courses and students respectively. The cost of the courses may, however, be segregated in two components: the new courses that are to be initiated and the courses, which are continuing and need only to be maintained (i.e. offered every semester/year by undertaking minor revision). The above given cost function can be expressed symbolically in the following form:

$$\boxed{TC = a + bC_n + cC_m + dS_n}$$

Where,

- TC = Total cost
- a = Fixed costs
- b = Coefficient of the number of new courses
- C_n = Number of the new courses
- c = Coefficient of the number of maintained courses
- C_m = Number of the maintained courses
- d = Coefficient of the number of new students
- S_n = Number of students

In this equation, b, c and d can be determined for any particular year by dividing the total costs allocated for the students, the new courses to be introduced and the courses to be maintained by the actual number of the students, the new courses, and the courses to be maintained respectively for that year.

Cost function: type 3

Let us examine another functional form for representing the dependence of costs on output or the scale of activity for distance education. The systems noted below are considered to be the important constituents of the total system of distance education:

- i) Production system (p);
- ii) Instructional system (i);
- iii) Evaluation system (e); and
- iv) Administrative system (a).

As discussed before, the total cost (TC) of the system consists of total fixed costs (say TF) and total variable costs (say TV). Symbolically,

$$\boxed{TC = TF + TV}$$

In this equation,

$$\boxed{TF = TF_p + TF_i + TF_e + TF_a}$$

Where,

TF_p = Total fixed cost of the production system

TF_i = Total fixed cost of the instructional system

TF_e = Total fixed cost of the evaluation system

TF_a = Total fixed cost of the administrative system

Similarly,

$$\boxed{TV = TV_p + TV_i + TV_e + TV_a}$$

Where,

TV_p = Total variable cost of the production system

TV_i = Total variable cost of the instructional system

TV_e = Total variable cost of the evaluation system

TV_a = Total variable cost of the administrative system

Therefore, the total cost is the summation of the above categories, and is given as follows:

$$\boxed{TC = (TF_p + TF_i + TF_e + TF_a) + (TV_p + TV_i + TV_e + TV_a)}$$

In distance education, most of the fixed costs denote the capital (K), and the variable costs are for the operations (O). The relevant values may be substituted accordingly:

$$\boxed{TC = (TK_p + TK_i + TK_e + TK_a) + (TO_p + TO_i + TO_e + TO_a)}$$

Once the total cost (TC) is calculated as above, the average cost of the system may thus be obtained by dividing the total cost (TC) by the total number of the students.

The types of media used for production and implementation of courses are of crucial importance in distance education. The cost components – fixed and variable, or capital and operational – are influenced accordingly. For the systems of production and instruction, both the capital costs (K) and operational costs (O) would vary with the types of media employed like the printed material, radio, TV, audio, video, tutorials, practical work, etc.

The total cost of an organisation, therefore, comprises of fixed costs, variable costs, and semi-variable costs. The behaviour of fixed and variable costs is shown in Fig. 3.1 (Rumble, 1997).

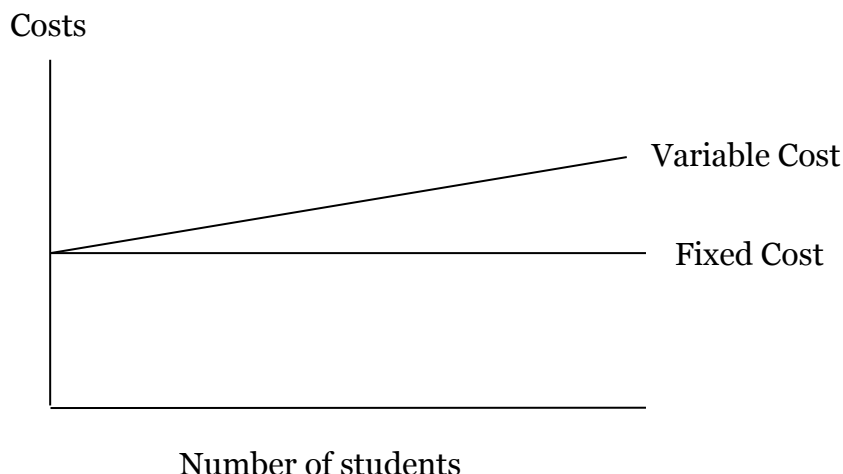


Figure 3.1: Fixed and variable costs

Semi-variable costs, as distinguished from variable costs, are those which bring about a change in fixed costs, like trainers or tutors and teaching or training rooms with an additional increase in the number of students.

3.4 ECONOMIES OF SCALE

‘Economies of scale’ constitute a significant factor in any study of cost-effectiveness. They are said to accrue or to have been achieved when the marginal cost of output declines. The extent of realisation of the economies of scale is directly proportional to the value of cost-effectiveness, i.e. when an institution increases the volume of activities with reduction in cost, cost-effectiveness increases too.

The analysis of the cost functions helps in determining the relationship between the average cost and marginal cost, and thus between economies of scale and diseconomies of scale. The prospect of economies of scale for a given system would be there to the extent of such additional units of output (i.e. additional student enrolment and graduation) **for which the marginal cost would be less than the average cost**. When the marginal cost of output tends to exceed the average cost, the phenomenon of diseconomies of scale is said to occur. By using the cost functions, as discussed in section 3.3 above, it is possible to analyse different components of the total cost and, accordingly, to assign appropriate weights to the components of the fixed and variable costs. Such analyses are of immense value from the point of view of examining the efficiency aspects of resource allocation. This is possible by studying the relationship between the volume of output and the amount of investment, and this tells the extent to which the benefits of economies of scale could be reaped. Because of the intensive use of educational technologies, especially the electronic media for imparting education, distance education could undoubtedly be made cheaper, provided, of course, that a minimum level of enrolment is maintained.

Activity 3.1

Distinguish between average and marginal costs. How is average cost calculated? Describe why does average cost increase in a distance teaching institution.

Answer within 100 words.

- Notes:** i) Write your answers in the space given below.
ii) Compare your answers with those given at the end of the Unit.

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3.5 COST ESTIMATION

Estimation of the costs of education is not a simple matter, though a number of studies have attempted to clarify the concept and simplify the procedure for such estimation. It should, however, be made clear that there is no single response to the question, because of the conceptual and statistical difficulties involved. Before discussing this aspect of estimation, let us examine the concepts of costs. Your working through Unit 3 of Block 1 and Unit 2 of this Block, we think, will have provided you some background on costs involved in distance education, which should help you understand a new set of issues in the area of cost estimation in distance education.

3.5.1 Which costs to look for and why

From the viewpoint of economic analysis, the proper definition of cost (**real cost** or **economic cost**) of an input to education is its **opportunity cost**, which is measured by the value of the input in its best alternative use. In other words, the real cost of education includes not only **public expenditure** on education but also **private costs**. Private costs of education include both direct monetary expenses for tuition, self-learning materials/text books, and other maintenance items and the indirect cost of the students' time measured by the forgone earnings in employment (i.e. if one would have got into a job without studying further).

Private costs of education are important to consider not only because they constitute a significant part of the real cost of education, but also because they can affect the demand for education. For example, for children in rural communities, going to school amounts to their not being able to help the parents in their farm-work and other household chores, which in turn reduces the resources of family welfare. This private sacrifice, at least partially explains the high drop-out rates in

rural primary schools, which frustrates the government's efforts in providing universal primary education. In such a situation, without intending to do so, the public authorities rely more on private contribution to educational expenditure, resulting in an increase in the private cost of education. Given the importance of private costs, it is unfortunate that sufficient data on private costs is generally not available. In distance education, the situation may be different since generally a sizeable number of students is already employed.

What costs to measure depends mainly on the purpose for which cost analysis is conducted. A key issue to consider is the "cost to whom". If one is concerned with the social efficiency of educational investment, then both public and private costs have to be included. If, however, one is concerned with the fiscal implications of an educational intervention, then it is the costs borne by the government that have to be estimated, even though fiscal costs and real costs may differ considerably. Another key issue to consider is which cost-measure is appropriate: average cost or marginal cost. If the decision is to determine whether or not to expand an existing programme, the amount of the additional cost is the issue, i.e., the marginal cost analysis is the most appropriate one. Average cost analysis is relevant if the decision involves a choice between different programmes to be offered.

3.5.2 Classification and calculation of educational costs

You have worked through the description of some educational costs in Unit 2. It is time we noted here that the classification of educational costs remains an unsettled area of cost analysis. Except for the costs of new educational media, there exists no internationally standardised classification of educational costs. Presumably, educational costs can be classified according to criteria that are economic (the resources used), institutional (the sources of support), financial (the time or period of expenditure), and technical (the functioning inputs). But the complexity of these issues and the variations among countries make a standardised classification difficult. Each country tends to have its own system of cost accounting. This creates problems for a cross-national comparison of educational costs.

Nevertheless, there are some generally accepted distinctions among educational costs. These include, for example, the distinctions between economic costs and expenditure, direct costs and indirect costs, recurrent expenditure and capital expenditure, variable costs and fixed costs, unit costs and marginal costs, public costs and private costs, personnel costs and non-personnel costs, and instructional costs and non-instructional costs. A number of problems arise in collecting the relevant data with respect to such classification. The relevant statistical information is generally collected by the Central and the State Governments, and that too with respect to public expenditure. There is, moreover, considerable lag in the availability of data for analysis and their use for decision making. More so, costing in distance education draws less attention and, therefore, such costing studies are rare.

3.5.3 Unit cost of education and its application

The costs that you have studied in Unit 2 of this Block are those from the point of view of the educational institution or any educational establishment. The cost of an educational innovation or plan is often expressed in terms of its total cost to indicate the total value of real resources devoted to it. But, in many situations, unit costs are more meaningful, especially for diagnostic, comparative, and evaluative purposes. A unit cost of education is the cost of an education unit or per student or per graduate. And this explanation is directly applicable to distance education.

From the point of view of the economic framework of educational production, a unit for educational cost refers to a unit of output of educational production. Education has multiple outputs, and these outputs have been measured in terms of student achievement, the number of graduates completing a course or programme of study, rates of literacy, numeracy and others. Given the diffuse nature of the outputs of education, cost analysts have often turned to educational production as a unit of analysis. On the basis of the previous works on costs, we have identified a number of unit costs of education as follows:

- i) cost per student enrolled;
- ii) cost per student actually attending an educational institution;
- iii) cost per graduate;
- iv) cost by level of education attained;
- v) cost per student of the relevant age group population;
- vi) cost of education per capita;
- vii) cost per class;
- viii) cost per hour;
- ix) cost per course;
- x) average recurrent cost per teacher; and
- xi) capital cost per place.

In the unit costs listed above, 'cost per student enrolled' is the most commonly used unit cost in planning education at all levels. Since there can be a large gap between the reported enrolment and actual attendance at the lower levels of the educational ladder, the actual attendance of the student is considered. Cost per student attending an educational institution indicates the unit cost associated with attendance. Cost per graduate is referred to as the 'effective' cost of education. The gap between cost per student enrolled and cost per graduate is a measure of the extent of repetition in the same grade/class in an educational institution. The ratio between them is sometimes taken as an indicator of the **internal efficiency of education** of the particular educational system/institution. Cost per graduate is particularly relevant for human resource planning purposes, as it relates to the number of persons who successfully complete a programme of study.

While the cost per graduate measures the unit cost at the end of an educational cycle, the cost by level of education attained measures the unit cost at a given level of education. The use of the cost per

educational level reflects the view that a learner who quits the institution at a certain level of education has nevertheless acquired some useful knowledge and skills. The cost per learner of the relevant age group and the cost of education per capita are measures of the extent of the coverage of an education system or a sub-system. Sometimes the cost analysts find it convenient to use the cost per grade or class in cost projections. But its utility is doubtful as there are significant variations in class size (in different regions, by education levels, etc.). The cost per hour is often used to express the cost per broadcast hour in TV broadcasting or teleconferencing, and this is seldom used elsewhere. Average recurrent cost per teacher is also used in costing because of the intensive nature of educational production, and the dominance of the teachers' salaries in public educational expenditure. Finally, the capital cost per place is used in projecting the cost of construction and equipment per learner-place provided.

Although the measure of each unit cost has its own application, and no one measure is suitable for all purposes of costing, **the cost per graduate and cost per student enrolled are commonly used in most of the educational costing exercises including distance education.** From the point of view of educational production, the cost per graduate is the appropriate unit cost of education. Although its computation is sometimes hampered by the lack of information about the number of graduates (by level of education, type of programme and type of institution, public vs private, rural vs. urban, etc.), its utility can be promoted by putting in more systematic efforts in the collection of such data. Despite the fact that it is an input measure, cost per learner enrolled is of great practical value to the policy makers.

Another major issue in expressing educational costs is the distinction between the cost at **current prices** and that at **constant prices**. The cost at current prices is measured in terms of the prevailing prices. It differs from the cost at constant prices in that the latter reflects the real value of resources at some base year prices. This is obtained by adjusting the current price with price indices for changes in the price level.

There is, however, a tremendous gap between the data which is required and the data which is available for cost analysis. In the face of severe fiscal constraints and the call for efficient utilisation of scarce resources for education, the need to strengthen the informational basis of cost analysis for educational decision making is both self-evident and urgent. A database of the cost of education is not adequate if it does not contain reliable information on the relevant categories of public costs (broken down in terms of input items and functions), and private costs (both direct and indirect costs) for various levels of education over time, and at various administrative levels (local, regional and central governments). There is obviously a cost for developing or improving such a data base; and the cost for uninformed educational decision making is considerably higher in the long run.

Activity 3.2

Describe “private cost” and “unit cost” of education per graduate; and find out the relationship between these two cost categories.

Write down your answer in about 12 lines.

- Notes:** i) Space is given below for writing your answer.
ii) Compare your answer with the one given at the end of the Unit.

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3.6 COSTING LEARNING RESOURCES

The development of learning resources/self-learning materials (especially print) follows the stages of pre-production, production, post-production, delivery, and training; and there are costs associated with each of these stages (Gaba, 2008). We incur expenditure for each of the following activities, and this becomes the costs for those activities.

Pre-production: The pre-production activities include need assessment and/or market research, expert group and course preparation team meetings and workshops, training of writers and editors, preparation of various concept notes and curriculum proposals, travels and stationery and allied expenses.

Production: This is the stage of actual development of materials for which writers, editors (instructional design editors, content editors, language editors, copy editors, etc.), typists and designers are to be paid. Even if one is adopting open educational resources (OER), many of these cost centres still prevail (though the cost of OER could be almost nil). This will also include printing costs.

Post-production: These activities include material acquisition from printers and its proper storage, including warehouses, inventory management, sorting out packets as per student course choice, etc.

Delivery: The delivery activities comprise of material dispatch to students, provision of tutoring and counseling, other technology enabled support like SMS service, training of counseling and secretarial staff and evaluators, and infrastructural and stationery expenses.

Training: The expenses depend on the mode and strategy of training, honorarium to trainers, lodging and boarding/online training expenses, training resources/kits, and post-training follow-up and monitoring of transfer of training/learning to actual work contexts.

3.7 LET US SUM UP

In this Unit, we presented some details about the importance of the study of educational costs from the point of view of determining average and marginal costs and of allocating resources to different heads. The items of expenditure in distance education differ significantly from those used in the conventional system of education and depend on inputs like teacher, self-instructional print materials, audio-video materials, academic-counselling, regional and local centres, teaching at-a-distance, and so on. This, along with the processes involved in teaching-learning at a distance, give rise to a new input-output relationship and changing interpretations of costs in distance education.

While talking about cost, we noted that in distance education, initially, fixed costs increase; and instead of teachers' salary taking a large amount of variable costs (as happens in conventional education), programme development-delivery-evaluation does so. We also touched upon the notions of average cost and marginal cost, and noted that both could be reduced by increasing the enrolment size and balancing the use of cost-intensive electronic media so that economies of scale are achieved. To further exemplify how cost of distance education is calculated, we briefly presented the case of development of self-learning print materials.

3.8 MODEL ANSWERS TO ACTIVITIES

Activity 3.1

While average cost is the total cost incurred per unit, marginal cost is the additional cost that is incurred on enrolling an additional student.

The calculation of average cost involves dividing the fixed cost by the total number of students and adding the variable cost per student to it.

In a distance teaching institution, the average cost increases either because the enrolment is low or the variable costs are very high, or both the factors together.

Activity 3.2

Private cost of education refers to the expenditure that an individual student incurs to get a particular type or level of education (viz., expenditure on tuition fees, books and stationary, travel, other fees, the income foregone, etc.). On the other hand, unit cost per graduate

includes all the expenses incurred to produce one graduate at a certain grade level. Therefore, private cost becomes a part of the unit cost of education, because the latter includes, besides private costs, institutional costs, and social costs (i.e. expenditure incurred by the public authority) per unit.

3.9 SUGGESTED READINGS

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UNIT 4 COSTING TECHNOLOGY-ENABLED LEARNING

Structure

- 4.1 Introduction
- 4.2 Learning Objectives
- 4.3 Making the Shift from F2F Teaching to Technology-Enabled Learning
- 4.4 Costing TEL: Framework of Analysis
 - 4.4.1 Development
 - 4.4.2 Delivery
 - 4.4.3 Maintenance
 - 4.4.4 Overheads
- 4.5 Calculating Costs of Online Learning
- 4.6 Research on Costing of TEL
- 4.7 Let Us Sum Up
- 4.8 Model Answers to Activities
- 4.9 Suggested Readings

4.1 INTRODUCTION

This is the last Unit of this Block dealing with costing of technology-enabled learning/online learning. We have discussed costing of distance education in the preceding three units covering costing in distance education, cost structures, and cost functions. Based on this understanding, it is time now to apply these in the context of online learning or educational contexts where teaching-learning is offered exclusively through web networks or technological delivery. We shall discuss the factors associated with TEL and various aspects relating to calculation of costs of TEL.

4.2 LEARNING OBJECTIVES

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

- describe technology-enabled learning (TEL), and what is required to shift from F2F teaching to TEL; and
- explain various costs involved in TEL, and the mechanism of calculating costs of networked/online learning.

4.3 MAKING THE SHIFT FROM F2F TEACHING TO TECHNOLOGY- ENABLED LEARNING

In case of the campus-based face-to-face (F2F) teaching-learning, the major requirements are buildings, classrooms, labs, libraries, support centres, curriculum, teachers, and students (and other non-teaching and support staff and administration). Teachers generally present lectures and interact with students, and teaching may be facilitated by use of some forms of technology. The major expenditures or cost centres are divided into three – academic, administration, and learner support. It is also a matter to note that almost 90-95% of expenditure in higher education in India goes towards payment of teachers' salary.

When a decision is made to introduce distance teaching, the major considerations include: development of learning resources (print, audio, video etc.), establishment of study centres/learning centres/work centres, and a system of communication with learners, which is technology-based. Though there are permanent/full-time teaching and non-teaching staff, most of the activities are carried out by outsourcing and/or by part-time staff like course writers, editors, media producers, tutors/counsellors, evaluators, etc. The four major activities, and, therefore, cost centres, in Distance Education have been discussed in section 1.4 in Unit 1 of this Block, which include design, production, delivery and evaluation.

In case of technology-enabled learning (TEL) systems and practices (which also include online learning/e-learning), the existing pedagogy of F2F and DE is augmented in six different ways (as noted by Ferguson, 2019):

Connectivity: The developments in internet and the semantic web provide for immense space and opportunities where teaching-learning can be more networked, collaborative, and, therefore, more dialogic/conversational (than what is possible in case of F2F or DE) in a seamless manner.

Extension: When learning becomes networked, the teaching-learning interactions and opportunities can be extended unlimitedly across time and space/locations, through the use of networked social technologies and social networks. This possibility leads to combination of F2F, DE and TEL in mechanisms that could be expressed in many forms of 'blended learning'.

Inquiry: Technologies and networks provide for instant access to information and data (other than what involves in a discipline/course-specific teaching-learning) such that learners (as well as citizens as lifelong learners) can critically review and reflect, and interrogate the existing information and methods. This also facilitates scientific investigation/inquiry in a collaborative manner, across national borders, which contributes to enhancing the quality of engagement and learning.

Personalisation: Along teaching-learning with technology, there is enough flexibility and scope for personalised learning, as also individualised development of skills and attitude. A seamless personalised learning path is possible through specially created individualised learning environment and personalised mentoring.

Publication: By accessing additional authentic resources and activities, other than what is given by teachers, learners can create their own products of learning outcomes, which can be shared and commented upon globally. In the process, learners develop critical thinking and reflection, and become creative.

Scale: Social technologies and networks, as also the massive open online courses (MOOCs), provide for additional learning at a large scale (and, many times, at no cost) and enhance learner's credentials and employability and life skills.

We have deliberately used the terminology 'technology-enabled learning' rather than 'technology-enhanced learning' (or technology-managed learning) in consideration of enabling the learner/user instead of enhancing anything including the ability to use (Panda, 2020). Kirkwood and Price (2016) provide a clear and practical conceptualisation: 'Technology-Enabled Learning is taken to refer to the application of some form of digital technology to teaching and/or learning in an educational context' (p.2). 'The word *enabled* refers to facilitation: learning is made possible by the use of technology' (p.3). Technological developments today include semantic web as also web 3.0 and beyond, and artefacts like artificial intelligence (AI) and internet-of-things (IOI). Within this conceptualisation, both e-learning (i.e. use of any electronic means for teaching-learning) and online learning (i.e. teaching-learning on the semantic web) are included. While we shall focus on costing of technology-enabled learning (that is possible through use of modern digital technologies) and that of online learning, we shall not consider the old media and old technologies like audio/radio and video/television, as also teleconferencing.

An institutional shift from F2F and DE to TEL and online learning would require investment on technology infrastructure (including the learning management system-LMS and data/resource repository server), and development of digital learning resources (including adapting open educational resources). Further, there will be investment on full-time staff and large scale part-time tutors, evaluators and may be web designers.

Activity 4.1

Describe technology-enabled learning and online learning, and identify institutional requirements for shifting from F2F and DE to TEL and/or online learning. Write in about 10 lines.

- Notes:** i) Write your answers in the space given below.
ii) Compare your answers with those given at the end of the Unit.

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4.4 COSTING TEL: FRAMEWORK OF ANALYSIS

The various activities and, therefore, cost categories in TEL and online learning can be grouped as follows (Bates, 2016) – development, delivery, maintenance, and overheads. Let's discuss these four areas as given below.

4.4.1 Development

In the context of courses using technology as also in cases of online learning, one of the major aspects is development of digital resources. The development of digital content may include hyper-linked texts, or videos, or integration of existing open educational resources (OER) in the learning management system (LMS). The costs centre around development of content and videos, time and money involved in hiring designers, salary of the faculty, payment made to web designers and media producers. Even if the programme/course coordinator and the teachers share a part of the entire course development, specialists are required to carry out specialised tasks, which teachers may not be able to do. The faculty time is also used for other important tasks like conducting training programmes and research, besides the digital/online course design and development. There is also design and /or clearance of copyright for pictures, videos and other digital resources if one is not using OER exclusively. The curriculum and instructional designers as also faculty developers are to be calculated in terms of their time (and, therefore, cost) devoted to the design and development of courses of various disciplines/departments. It may be noted that the design and development costs are 'fixed' costs, which need to be invested irrespective of the number of students to be enrolled later in the programme/course.

4.4.2 Delivery

Once the courses are developed and the LMS is designed and made fully operational, there is student enrolment, and teaching of the courses either fully online or through blended delivery approaches. The teachers/instructors/online tutors are to be paid for online interaction and presentation, assessment of assignments, initiating and facilitating discussion forums, online support, among others. The delivery costs will depend on the number of students enrolled, and, therefore, are recurring and 'variable'.

4.4.3 Maintenance

Once the digital teaching-learning or online LMS is made operational, the courses and LMS need to be maintained in terms of rechecking the online links/URLs, revisiting the online resources or open educational resources, adding new contents and/or revising old contents. The maintenance costs do not depend on student enrolment, but are functions of the number of courses to be maintained and the nature of the course (i.e. if it involves addition of more video, changes in practical and/or hands-on activities, etc.).

4.4.3 Overheads

The overheads are largely related to infrastructure costs including those of LMS, servers and other hardware needed for audio-video capture and animation. The overheads need to be apportioned across various programmes offered in a particular year or semester. The overheads are generally institutional costs irrespective of programme directors using or not using these facilities.

As seen above, various factors contribute to the cost of a digital or online course. These include design and development of teaching-learning resources, course delivery, number of students enrolled in a course, level of efficiency of faculty and infrastructure, and hiring of experts. Therefore, if OERs are used, the cost of design and development can be reduced; and, on the other hand, more of activities and project work and more of interaction and collaboration shall increase the cost.

4.5 CALCULATING COSTS OF ONLINE LEARNING

As you already know, in the conventional education, the variable costs are always higher than the fixed costs. The reverse is the case for TEL/online/virtual education. Therefore, for TEL to be cost-effective and cost-efficient, it is necessary that the fixed costs are reduced as much as possible.

Besides fixed and variable costs, costing experts take into consideration the 'opportunity cost', i.e. cost of alternative uses or earnings forgone while going through an educational diploma or degree. When opportunity cost is considered, the difference in the unit cost of online education and F2F education is lower than situations where any institutional costs are considered. Generally, the fixed costs in F2F education are lower than the variable costs, whereas in online education/TEL, the fixed costs are higher and variable costs are lower than each other. This is the case in context of institutions being single-mode, i.e., exclusively either F2F (i.e. campus-based) or distance teaching institution/open university/virtual teaching institution.

In case of dual-mode institution or where an institution uses blended teaching-learning, the same technology infrastructure (which is fixed

cost) is shared between F2F teaching-learning and online teaching-learning. Further, the variable costs are also reduced by using digital learning resources for both the modes of delivery. Therefore, both dual-mode or multi-mode institutions and those using blended teaching-learning are liable to achieve lower unit cost and higher economy of scale than the single mode institutions.

There are also other factors, which affect the cost of virtual or online education. There are instances where online education is treated very differently from that of F2F education in so far as government funding is concerned. While F2F education is fully funded, there may not be any support available for online education, thereby compelling it to either increase private cost or decrease the quality of teaching-learning, or even both. Related to this are quality assurance and accreditation mechanisms for F2F and online education, which generally are different from each other. Quality assurance indicators are required to be the same (and especially in the context of learning outcomes) whereas the modes of delivery may be different. At times, the pressure of stringent technology deployment for exclusive single-mode online/virtual universities increases the cost of infrastructure (and, therefore, the fixed cost as well as the unit cost). The context of dual-mode or multi-mode teaching in the United States, for instance, offsets both fixed and variable costs due to sharing, and thereby reduces institutional cost and possibly unit cost too.

As we have already discussed, costs for online learning/networked learning can broadly be divided as development costs, delivery costs, maintenance and administration costs, and overheads. The factors which are generally associated with costing include: the student number, number of courses offered, lifetime of courses, the media and technology-mix, use of open source technologies and open educational resources, institutional versus private costs, ratio of full-time and contractual experts and staff, course design and development models, use of virtual lab or student home experiment kits or blended hands-on, among others.

Technology provides for flexibility in both teaching and learning strategies, going beyond the traditional Fordist or linear approaches. While the Fordist, or in a way the behaviorist, approach may reduce institutional cost, the open and flexible approaches will generally increase the institutional and unit costs. Even within TEL/online learning, the Fordist approaches adopted by for example the xMOOCs (fixed teaching provisions with less interaction/collaboration/engagement by learners) are less expensive or cost-intensive than the qualitative and flexible approaches adopted in case of cMOOCs (based largely on collaboration, interaction, engagement, and reflection).

While noting disagreement among experts regarding a general framework for costing of online learning, and that costs could be calculated on the basis of expenditure category, or by contributor, or by distinguishing capital and revenue costs, Rumble (2001) provides for a functional approach in which distinction is made in the factors between online materials development, e-education delivery, and overhead costs. These are briefly specified in Table 4.1 below.

Table 4.1: Expenditure descriptor for networked/online learning

Expenditure descriptor	Expenditure category	Explanations
i) Development of e-materials		
Materials	General comment	Online courses may include use of existing text books and OERs; and use of audio, video, image, virtual reality. Since materials can last for several years, there is annualisation of cost. Common materials like prospectus, rules and regulations, exam procedure are common to all students and should be costed across programmes.
Staffing (cost of staff time on instructional design, software development, multimedia, course software development, content testing and training)	Human resources	The actual staff time devoted to media production depends on which media is being used. It also depends on whether separate persons (or one person) perform the tasks of material development, online tutoring, and online assessment. Also whether there are core full-time staff or contractual staff. In dual-mode institutions, staff time is devoted to all delivery modes, and for certain tasks on extra payment.
Staff equipment	Equipment	Institutions may provide their computers and systems for staff to work, or ask staff to use their own laptops/desktops, etc.
Copyright clearance	Expenses	If third party material is used, copyright clearance is an additional significant cost.
Material production (of print, audio, video, graphics, software)	Staff costs, stocks, supplies, consumables	Costs will depend on what media is used – CD-ROM is more expensive than audio and video; and multimedia with animation is most expensive.
Material revision	Staff costs, expenses	There may be periodic revision, semester/annual preparation of assignments, etc.
Developmental testing	Staff costs, expenses	Involves payment to field investigators and content/language experts.
ii) E-learning costs		
Materials delivery (distribution of electronic materials, CD-ROM, manuals, etc.)	Expense	Cost relating to courier, online delivery of ethereal goods.

Expenditure descriptor	Expenditure category	Explanations
Materials reception	Expense	Incidental costs of reception, additional purchase of materials.
Student/tutor equipment	Equipment (capital)	It depends on whether the institution provides equipments to students and teachers, or expects them to use their own systems. And, there is need for annualisation of such expenditure. May be the core staff are provided with such facilities, while non-core staff are required to use their own systems.
	Software	While the system may contain bundled software, additional software may be purchased with extra cost. As a capital cost, this may require upgrading from time to time.
Student/tutor expenses	Expense	May require payment to internet service provider (ISP) as well as energy/electricity costs. This also includes wear and tear/repair and insurance costs.
Opportunity costs (cost of student time)	Opportunity cost for all students; staff cost for firms	Experts argue to place a value for time spent by every student; and the employers consider this as full opportunity cost at the time of training.
Tuition	Staff, expenses	The tuition cost, i.e. payment to teaching staff and lab assistants and also payment to part-time staff.
Student/tutor helpdesk	Staff cost	Payment to helpdesk staff/call centre staff; many times there is an automated query-response system.
Call costs	Expense	There may be toll-free access or students/teachers pay for themselves for such telephone calls.
iii) Overhead and infrastructure costs		
Decision making	Staff	The time (and, therefore, cost) devoted by the management/committees/expert groups to make decisions on online/virtual education and training. This also includes cost of visits, consultants and advisors.
Institutional evaluation/QA expenses	Staff, expenses, consumables	This includes cost of survey, production of reports, advocacy, etc.
Web development	Staff cost	Payment to the staff/consultant for development of websites for OLL.

Expenditure descriptor	Expenditure category	Explanations
Software and computers	Capital	Annualisation of infrastructure; updating and replacement costs.
LMS software, network server	Capital, equipment	Initial LMS cost and server cost; cost of annual updating and maintenance.
Building and accommodation	Capital expense	This cost towards office space, etc. needs to be annualized. This may include the entire building. Many times the space cost includes provision for workstations and other facilities.
Intranet/LAN cost	Capital	Additional cost towards institutional intranet. Such costs need to be annualized.
Furniture	Capital	Both dedicated and shared staff workstations.
Equipment and furnishing	Capital	The workstation or tele-centre needs provisions and facilities.
Marketing	Staff cost	Salary and other costs.

Activity 4.2

Briefly describe the major cost centres in networked/online learning.

- Notes:** i) Write your answers in the space given below.
ii) Compare your answers with those given at the end of the Unit.

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4.6 RESEARCH ON COSTING OF TEL

We shall examine in this section the findings of available studies on cost of TEL (and especially online learning) – those which support it to be cost-efficient and those which do not. You will find important studies on cost of distance education (DE) given in Block 4 in detail; and in Block 5 we have included significant studies on costing of online/networked learning, including that of Rumble (2001).

The most significant and widely consulted study on costing of networked/online learning (OLL) is that by Rumble (2001) who discussed various aspects on costing of OLL in relation of learning materials, e-delivery, e-administration, and reported comparison between F2F and e-education, and between DE and e-education. For the Arizona Learning Systems in the US, Rumble (2001) provides the following cost estimates for various media for a 3-unit internet course:

Course components	Cost (US\$)
Course outlines and assignments	6,000
Text	12,000
Text with reference material	18,000
Text with reference material and images	37,500
Audio and video	120,000
Simulations	250,000
Virtual reality	1,000,000

From the above table, you can very well deduce that more the use of simulations and virtual reality; more will be the expenses and, therefore, higher unit cost. It has also been noted that synchronous communication costs less (since it takes less preparation/staff time) in comparison to asynchronous communication. Most of the research studies show that in virtual/online teaching-learning which is media-intensive, it is the labour cost, which occupies the largest chunk of institutional and unit cost.

It may be noted that once the resources are digitized, the e-delivery costs for online learning can be considerably reduced (in fact is less than the delivery costs of DE and traditional F2F education). The same is the case with distribution through online resource repository (like *eGyanKosh* of IGNOU) and online digital library networks (like National Digital Library, India). Online resource-based learning increases student self-learning and reduces tutor teaching time; and online collaboration and discussion forum is certainly less expensive than DE study centres and F2F classrooms.

Activity 4.3

Briefly summarise the main research findings on costing of networked/online learning.

Notes: i) Space is given below for writing your answer.
ii) Compare your answer with the one given at the end of the Unit.

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4.7 LET US SUM UP

In this last Unit of this Block, we discussed various aspects of costing in networked and online learning. We distinguished between F2F education and online education will require initial investment on infrastructure, development of e-resources, and investment on training and re-training of faculty and other staff associated with virtual education. The major cost centres include design and development, delivery, maintenance, and overheads. Also we noted that more sophisticated the use of media like animation and virtual reality, higher will be institutional and unit costs.

4.8 MODEL ANSWERS TO ACTIVITIES

Activity 4.1

Technology-enabled learning refers to teaching-learning contexts or systems where the entire process of teaching-learning is carried out by or with the help of technology exclusively. Learning is considered an individual activity which takes place within the cognitive structure of an individual by utilizing one's own psychological abilities (cognitive, affective, and psycho-motor). Technology use facilitates this process of enabling an individual to use one's own learning abilities most effectively, rather than enhancing anything. The enabling role of technology may take place when one is studying by self, or in the classroom, or at a distance. Online learning refers to situations where the entire teaching-learning takes place online (both synchronous and asynchronous), largely through the web, and also through telecommunications technology. An institution, in order to shift to TEL or online learning, needs to establish systems of learning management system (LMS), develop digital learning resources, deploy faculty and staff well-trained in TEL/online learning including web design and online support, interaction, and assessment.

Activity 4.2

In the context of networked/online learning, the major cost centers include: i) design and development of digital/e-resources, including adapting open educational resources, ii) e-delivery, which requires LMS and interaction and discussion, as also carrying out assignments, portfolios etc. on the LMS, iii) maintenance, which includes new assignments and projects, updating of e-resources, etc., and iv) overheads, including infrastructure.

Activity 4.3

To summarise the research studies on networked/online learning, it can be concluded that an increase in the use of expensive media like simulations and virtual reality (and those which are labour-intensive) increases the institutional and unit costs of education. Moreover, post-digitisation of resources, the delivery cost of online learning is always lower than that of distance education and traditional F2F education.

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