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# UNIT 4 COSTING TECHNOLOGY-ENABLED LEARNING

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## 4.1 INTRODUCTION

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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.

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## 4.2 LEARNING OBJECTIVES

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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.

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

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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

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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.

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## 4.5 CALCULATING COSTS OF ONLINE LEARNING

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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**

<b>Expenditure descriptor</b>	<b>Expenditure category</b>	<b>Explanations</b>
<b>i) Development of e-materials</b>		
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.
<b>ii) E-learning costs</b>		
Materials delivery (distribution of electronic materials, CD-ROM, manuals, etc.)	Expense	Cost relating to courier, online delivery of ethereal goods.

<b>Expenditure descriptor</b>	<b>Expenditure category</b>	<b>Explanations</b>
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.
<b>iii) Overhead and infrastructure costs</b>		
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.



<b>Expenditure descriptor</b>	<b>Expenditure category</b>	<b>Explanations</b>
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

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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

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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.

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## 4.8 MODEL ANSWERS TO ACTIVITIES

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### 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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## 4.9 SUGGESTED READINGS

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