

E-learning: Opportunities and Challenges

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1 Background

Almost everyone, some way connected to education, would have come across the term e-learning. A simple google search on e-learning would bring up many thousands of pages. One can find dozens of books on the topic. But a closer inspection of these materials and people's perception of the meaning of the term e-learning shows a wide range of variation. As we will see below, elearning does indeed have many dimensions and approaches, with associated spheres of influence. One size does not fit all. Often there is a tendency to copy models being tried out by somebody else, without bothering to carryout a detailed evaluation of that approach particularly in the context of the requirements and constraints present in one's own environment.

Such perception variation can be seen not just at the management level, but also among teachers and students. This article attempts to sketch the landscape of e-learning, evaluating the major aspects in context. The bottomline advice is that you have tremendous gains from practicing e-learning, provided it is done carefully and systematically. We attempt to show how in the rest of this paper.

We start with an outline of the e-learning landscape introducing the common variants briefly. We then look at reasons for opting for e-learning. While some of these are obvious, there are others which are often overlooked. E-learning when used effectively is not simply an add-on, but impacts all aspects of the teaching-learning environment. We elaborate on this, covering the teaching learning process (TLP), the teacher, the student, etc.

The rest of the article introduces the major components of e-learning and provides an overview of the components, highlighting the issues, opportunities and challenges in the respective aspect. We also include pointers to open source tools for many of these components enabling the reader to experiment and innovate with minimal investment.

2 The E-learning Space

The term e-learning, in the most general sense, refers to use of computers and communication technologies in the teaching learning process, with the intention to enhance its effectiveness. The idea of using technology in classroom is not new. From use of projectors, calculators, and relatively more recently slides are all familiar examples of this idea. On the other extreme, one can visualise a completely electronic learning scenario with no direct human involvement in the role of a teacher. In between, there is a wide spectrum of points. One can use these technologies to affect different aspects of the TLP. The list below gives you a feel for these.

Communication	e-mail, discussion board, chat
content	slides, slides on line, web resources, simulations
assessment	assignment online submission, online test

You can choose pretty much any combination from this. The choice could be dictated by aspects such as your own level of comfort with use of technology, the resources available to you for use, the institutional norms, the nature of the subject, the nature of the learner, etc. While it is difficult to call just using slides as e-learning, somewhere along the spectrum you move into e-learning. It is hard to draw a universally acceptable dividing line, and perhaps it is of no interest either. We are concerned with the effective use of these technologies to enhance TLP, rather than determining if you are practising e-learning or not.

A common phrase that props up in most discussions of e-learning is *Anytime, Anyplace, Anypace learning*. What does this mean? In traditional classroom learning, the teacher and the learner assemble at one prespecified place - the classroom normally - at a specified time. If a learner comes late or is at the wrong place, he would miss the instruction. Similarly, all learners are expected to follow the same pace set by the teacher. The mechanism cannot adapt to the pace variation among the different learners. Thus, this mode of instruction is same place, same time and same pace. You can relax one or more of these, substitute 'same' by 'any'.

For example, *any place*, relaxes the need to gather at one single place. The teacher and the learners can be at different geographical places, but the time synchronisation is retained. Video lectures broadcast live is an example of instruction by this mode. *Any time* relaxes the need for teacher and learner to be available at a common time. When you make content available on your website - video, slides, notes, etc - so that learners can access and peruse them when they want to, you are enabling anytime learning. Any pace is relatively more challenging. In any pace learning, different students can follow the course at their own individual pace - a fast learner can finish the course in shorter time than a slow learner. While the three sound similar, the complexities of implementing the three from the perspective of pedagogy, technology, software complexity, etc are quite significantly different. Any place is generally handled by making the course accessible over the web, so that

anyone connected to the web can access. The pedagogic implications of lack of face to face contact can be partially alleviated by use of video connectivity, though it is expensive in bandwidth and cost. Any time largely requires the course to move away a lecture based format, since the teacher cannot assume the presence of the learner when he/she delivers the lecture. Similarly, the teacher may not be available when the student is perusing the content and wants to ask a query. We discuss the time issue again in the next para. Pace relaxation requires significant changes in the course plan itself, since different students may be at different stages in the course at any time. These require changes in all aspects of the e-learning framework.

Apart from this range of options, there is another important dimension in the e-learning space - of time synchronisation. This is closely linked to the any time learning issue discussed earlier. We classify same-time e-learning as synchronous learning - both the teacher and the learners are present at the same time - and any time learning as asynchronous. Synchronous learning resembles the traditional classroom learning but for the fact the participants are physically spread out geographically. This is also called virtual classrooms (in contrast to the physical classroom). The primary technology constituent for this mode of learning is a mechanism to transport the teacher's activities - primarily lecture, slides, etc - to the students and their questions and comments back to the teacher, *in real time*. A number of tools are available for this (see section 10 for examples). The alternative mode is called Asynchronous learning. Here it is not assumed that the teacher and the learner will be online at the same time. Web based learning, in general, works on this mode. And much of this article will also focus on this. This mode uses content repositories for offering content, and discussion boards, e-mail, etc are used for communication. Chat, which is a synchronous tool, is also often included for discussions. These elements are discussed in subsequent sections.

As often happens with contrasting approaches, one can see approaches using a combination of both elements. These are called blended learning, since the effort is to blend traditional classroom-style synchronous learning with web based asynchronous components. Most of the literature currently advocate a blended learning model to start with.

There are a few more terms which often comes up in discussions of e-learning. From the early days of computing, people have been talking about using computers for enhancing TLP. That brought computer based tutoring (CBTs) into existence. A computer is used as a stand alone device here. There is no use of internet or any communication tool. Where e-learning scores over this, is in its ability to bring the power of communication and collaboration technologies into the learning process, along with the vast resources available over the Internet. So, we will consider e-learning to mandatorily require the use of Internet and communication tools which allows the user to interact with other learners and teacher.

Intelligent tutoring systems, another relevant term, was an attempt to mimic a

human teacher beyond the delivery of content. It tries to incorporate a deep understanding of the domain of teaching, pedagogical principles, remedial instruction, high degree of individualisation, etc and provides more tutoring than instruction. It uses sophisticated computer science technologies such as artificial intelligence. This is discussed in more detail when we talk about content.

Recently, there are also talks about m-learning, where the attempt is to exploit the fast growth of mobile and handheld devices in imparting education. While there are severe restrictions on this technology to provide the full functionality of a normal educational environment, it is found effective for specific learning activities, and is now an active area of research.

3 Why E-learning?

The need for e-learning has as many different answers as the number of different perspectives on e-learning that people have. E-learning is seen as desirable from a number of perspectives. We outline some of these below. The specific need you relate to, quite significantly determines your approach to e-learning. It is, therefore, important to carefully analyse this and choose a position.

- **Teacher shortage.** In many disciplines, shortage of qualified teachers is a problem plaguing most educational institutions. The quality of the available teachers is another major concern. Given the financially attractive opportunities in the industry and poor academic environment that is seen in most of the educational institutions, teaching job is among the lowest in the preference list for many. While hardly anyone looks at e-learning as an alternative to traditional teaching, in this context, it is seen to expand the reach of the available teachers.
- **A3 (any time, any place, any pace) learning.** As mentioned earlier, for many, the need to come together at a fixed place at a fixed time is a major constraint. This is particularly true for those pursuing courses in part-time mode, the just-in-time learners, adult learners, etc. The freedom to connect to the course setup at any time of your choice, and from any place is a major incentive for e-learning. It also enables learners to take to studying when they feel is the best time for them to study, and hence provides for adapting the TLP to the learner's individual characteristics.
- **Enhanced learning experience.** This is a very important, but often ignored and under-explored aspect. When exploited effectively, e-learning enables a high degree of personalisation and a wide range of instructional methods. Powerful simulation environments, multimedia capability and high-end visualisation

support enables a learner to relate to the subject much more deeply and hence understand well. Online assessments provide a world of opportunities to further enhance the TLP as we will see later in this paper. In my view, this ought to be the best reason for a teacher to adopt e-learning. The opportunity to incorporate the vast variety of content and resources from the web is also a significant benefit.

- Content creation. India, despite her IT-prowess, is still a poor contributor of content in the Web. Part of the reason is that very few of our teachers are online. While we happily use online courseware from sources such as MIT Open Course Ware (OCW), we rarely consider contributing our work to share with the world. Adopting e-learning enables and encourages one to do this naturally: your work is already online, perhaps with a limited reach, and once you are comfortable with this, it is a small step to reach out to the world.
- Enhancing quality of teaching. When one gets into practicing e-learning to any significant degree, one will be creating much of the course material electronically. These are a lot more reusable compared to written notes, used otherwise. These can also be shared with other teachers, can be improved over the years using user feedback, and hence results in better quality of material.
- More systematic feedback and evaluation. Bringing assessment and other activities under e-learning enables you to gather much more detailed feedback on various aspects of the course. These include quality of questions, quality of content, qualitative judgement on students' performance, etc. These can be used to enhance the quality of instruction at an institutional level.

From the list given above, one can see the many types of benefits that e-learning can bring in. However, as mentioned in section 1, e-learning offers a rich set of options to choose from. Proper choice of these options is important to reap the intended benefits. This article aims to equip you with the understanding necessary to make that judgement.

4 Aspects of E-learning

What are the components that make up a course? The main components that we see are the teacher, the learner, the content, the assessment mechanism, communication and collaboration mechanisms, and the administrative aspects (however small or big they may be). In e-learning also, one needs to have all these. Some of them changes in style to suit the new medium; but most of these exist in a visibly recognisable form. In the next few sections, we discuss each of these components in some detail. Before that, we will spend a little time on discussing the role of teacher and learner in the e-learning scenario.

In traditional learning environments, teachers are often the 'sages on the stage' - the undisputed authority on the subject. For any queries, the learner approaches the teacher. In e-learning, the students have access to much richer sources of information than the teacher - the internet resources and the vast amount of expertise available thus. The notion of a sage is no longer valid. E-learning parlance visualises the role of a guide by the side. It is not unusual that a teacher may learn from the students, during the TLP. Accepting this role, enables the teacher to reduce the laborious 'content delivery' component in teaching, and focus on the needy cases - those who are unable to cope with the class and those who are ahead of the class. The availability of detailed information about the students' progress, the record of the students learning activities, etc online enables the teacher to understand the students on a personal basis in more detail, thus, enhancing the quality of interventions.

Now we discuss the major aspects, content, assessment and communication, in some detail.

5 Content

Content is undisputedly the most important part of a TLP. It has, in turn, multiple aspects: the creation, management, delivery, etc. We will define content as what is communicated to the learner, directly or indirectly. Lectures, papers, books, etc are all types of content. Content is designed to meet some specific objectives.

A companion article in this handbook discusses the issues with respect to content in detail.

6 Assessment

When you give a task — a question, an assignment, etc — to a student and he responds to it, the quality of response is determined or at least influenced by a number of factors. These include:

1. the complexity of the question compared to the competence expected of the learner,
2. the quality of teaching imparted relating to the topics relevant to answering that question,
3. the level of the student's understanding of the topics,
4. the clarity of the question - ambiguity, ease of understanding, availability of relevant parameters, etc

Most of the time, we combine all of these into the third factor! Potentially, an assessment in a class can be used to produce inputs from all these perspectives. Note that one answer from one student may not yield any useful information. But collecting information over various assessments over many students can certainly provide useful inputs for all of these - something that computers can enable quite easily.

In conventional scenarios, very rarely does such analysis happen. One major cause is the inability to obtain fine grained data in machine processable form. One often restricts evaluation of assessment to determining the total marks obtained. Assessments reduce to a device for determining if a barrier has been cleared or the relative rank of a set of candidates.

Moving the assessment to electronic form can enable everyone involved to gain much more out of this process, including the kind of feedback mentioned earlier. Apart from the final answer of a student, one can monitor a number of other parameters which can contribute to computing such feedback. For example, we could record the order in which a student answers the questions in an examination, the number of times he visits a question, the number of times he changes the answer, total time spent on the question and so on. All these provide useful clues to estimating the various aspects mentioned above.

Doing assessments online has five stages:

1. creating and managing a question bank online
2. creating a question paper from such question bank(s)
3. allowing students to answer this paper online
4. evaluating the answers with computer help - fully automatic, semi-automatic, etc
5. post assessment analysis

One can potentially adopt use of computers for any subset of these stages. For each stage, there are issues, advantages and disadvantages. We discuss each briefly below. Before that let us briefly see the different assessment types generally used and some new models emerging in the context of e-learning.

6.1 Assessment Types

We can classify assessments based on various factors such as the nature of response, time allotted, access to other resources, the objective of the test, etc. Thus we can distinguish between open book and closed book examinations from the perspective

of access to other resources. The nature of response would lead to classes such as viva-voce, written test, performing a task, etc. We will restrict to classification more relevant from the perspective of e-learning:

- written test. Against a given question paper normally containing multiple questions, the student provides answers question by question. We will come back to different types of questions shortly. The answers may be given by ticking options in an OMR sheet (where the possible options are provided in the paper as in case of a multiple choice question), by writing them on paper, or by keying in the answers on a computer.
- Practical test, where a student is given a task to perform and the results are to be submitted for evaluation. Often the evaluator would check the experimental setup as well. Depending on the nature of the task, the work may be done in a lab (physics, chemistry, etc), outdoors (e.g. study effect of pollution), using a computer (write a program or analyse data), etc. Mostly these exams are not amenable to be brought under e-learning, though there are active research work in creating virtual laboratories in many areas. Section 10 lists a few relevant sites that you can check out. We will not be discussing this type of test further in this article.

Written test is a broad class covering a variety of testing types and question types. For example, open book examination vs closed book examination, with strict time constraints (as in a normal examination) vs loosely time bound (as in a take home exam), etc. Structurally, assignments requiring a writeup as response (study report, technical writing, etc for example), can also be considered as a written test. We can further detail the written test component in terms of the nature of questions used.

- The most popular question type from an e-learning point of view is multiple choice questions (MCQ). This has a question stem and a small set of candidate answers. The student is expected to choose a subset of this as the correct answer. It is common to restrict the selection to just one option (Multiple Choice Single Answer). However it is possible to have more than one option as correct (Multiple Choice Multiple Answer). The main strength of MCQ is the possibility of an automatic evaluation - it is relatively easy to match the user's selection with the intended subset of correct options. One disadvantage of MCQ is the relative ease for students to copy answers from other students or other sources - as we will see later, there are some interesting techniques to control this to a large extent. Making (some times wild) guesses is also easy since the possible answers are given in the question - he does not need to know anything about the subject to make a guess. Due to some of these

reasons, there are people who insist on non-MCQ component in any significant evaluations.

- There are many variants of MCQ which appears in different forms. Matching two columns of items (diseases and symptoms, for example) is a good example. Most of the plus and minus points of MCQ applies to this also. To reduce guessing, it is customary to have more elements in the target column than in the source column.
- Fill in the blank shares some strengths of MCQ, but reduces guessing chances. However, automatic evaluation is more difficult. Minimally, the system need to worry about different ways of writing the same response (if it is more than a word), spelling variants and errors, etc. In most cases, the response variations are not very large and hence these can be considered as an extension of MCQ (where the options are not visible to the user).
- Short answer questions go beyond fill in the blanks, and take a couple of sentences or phrases as answer. These are beyond automated evaluation at this time - evaluating multi-sentence answers is an active area of research, particularly for essay type questions. Normal examination papers tend to contain a fair number of short answer questions. The evaluation usually looks for some key ideas or steps.
- Long answer questions provide for a sharper judgement of the student's understanding since remembering long answers is comparatively difficult. Plus by suitably revising the questions, the direction of the answer can be controlled - defend, evaluate, compare, etc. However, evaluation of long answer questions is an error prone process even for human evaluators - it is tough to maintain consistency across students. And usually an evaluator does not get enough time to do a thorough read of the answers, and relies on a general scan for evaluation.
- Structured long answer questions are variants of long answer questions which are not completely open ended. There are clearly visible stages in the answer and hence complexity of evaluation reduces and consistency is improved. For example, 'describe the presidential election process in India'.

In addition to the variety in the question types, the question paper itself shows a high degree of complexity. A typical paper would consist of multiple parts - divided based on syllabus, level of understanding (ref Blooms taxonomy), etc. One can find options (e.g., answer any three) at different levels - among parts of a question, among questions, among parts, etc. There may also be maximum ceilings at various levels. For many universities, the breakup of the paper is much finely determined and all examinations must adhere to the same. These can make automated assistance in

question paper preparation, conduct of examination and evaluation a non-trivial task. CDAC Mumbai has a testing framework which supports complex paper support and provides intelligent directions and feedback to the candidate during the examination and the evaluator during correction.

6.2 Assessment and Security

Unlike the instruction process, assessments have a high degree of security concerns, since this often results in a student being assigned a label - pass/fail, winner, etc - and often the stakes are high on the label. So, one has to ensure that the person getting a label deserves it in both ways - that he deserves nothing better, and nothing worse. Of course, the major responsibility here lies with the teaching process, the nature of test used, the nature of evaluation, etc. Equally important are probabilities of some one else taking the test instead of the actual student, copying answers from elsewhere including fellow students, wild guesses, etc. A test environment need to protect against all these well - and it is a challenge particularly when someone takes a test online. A companion article in the handout explores issues such as plagiarism and biometrics. Plagiarism is when a student response closely resembles another document to believe that the material has been largely copied. This could happen in copying essay questions and assignments from a fellow student, or taking material without attributing citation from Internet or other published sources. This is a difficult problem, and fairly powerful solutions are available for specific type of scenarios. Biometrics is the use of suitable identification mechanisms which can certify that the person in front of the machine is indeed the intended person. These cover use of finger print, retina scan, etc.

One can also consider using technology solutions for preventing malpractices such as copying. As mentioned earlier, MCQs are most vulnerable to copying. However, this can be controlled to a large extent through a set of scrambling steps. With an online testing environment, it is not difficult for the machine to present the same set of questions to different users in different order. This means that you and your neighbours are having different questions on your screen at any time and hence not possible to copy solutions. You can go further to even have different subsets of a set of questions to different persons. This way, you dont even know if your neighbour will ever get the same question. Many software systems also provide option scrambling - so for the same question, your A is my C, and so on. These are effective copy-control measures which are relatively easy to implement in an online testing environment.

6.3 Doing Assessment Online

As mentioned at the beginning of this section, one can divide the various activities associated with an assessment into five stages. We briefly discuss these here.

6.3.1 Using a question bank

Though one can prepare questions for an assessment as needed, using a question bank has many advantages. A question bank allows you to keep track of the questions you have created over a period of time, along with a number of relevant parameters such as expected degree of difficulty, type of question, topic to which the question belongs, and so on. Having such a repository allows you to keep updating the questions based on feedback received from actual tests - fixing ambiguities, adding clarifications, etc. It also allows you to revise the degree of difficulty measures and expected time required to answer, etc based on observations from real tests. Therefore, over a period of time, the quality of your questions would improve.

It can also be used to keep track of when you used a given question, and hence ensure that questions are repeated not too frequently. A good question bank allows mechanisms such as automatic paper generation or paper scrambling to be effectively done.

6.3.2 Creating a question paper

As mentioned earlier, a question paper can be a simple sequence of questions or a very complex nested structure, often seen in University examinations. For most examinations, a template structure would be defined accordingly. The task of preparing a paper, then, amounts to identifying questions to fit the various slots as per the constraints of nature of question and marks allotted. A question bank can significantly help such a task.

Automation of question paper preparation is often done to a partial extent where the machine helps the user to navigate the set of questions, select what is appropriate and provide continuous feedback as questions are added/removed from the paper. The system can highlight areas still to be filled in, the degree of coverage of syllabus (as indicated by the topic fields of the questions), average degree of difficulty, etc. There are also attempts to completely automate the paper preparation - but this is often a very difficult task given the number of parameters that need to be optimised.

Such papers can be either printed out and used in normal test environments, or set up for online test. Depending on the requirements, the system can automatically generate variants of the paper for scrambling, etc - in print form and also online.

6.3.3 Conducting an examination online

Providing an environment for answering an examination online is a non-trivial task. If the paper is full of multiple choice questions, the interface consists of a way for the student to select the right option among those provided. For an essay question, a textbox would be required, preferably with additional support to draw pictures. More sophisticated interfaces are required for ordering questions, matching questions, etc.

In addition, high reliability is critical here in that if a student has answered a question even partially, the information should not be lost, irrespective of any failure of the system. Protection against connection failures, power failures, etc need to be built in here.

Support should be and can be provided indicating the time left in the test, questions yet to be answered, worth (in marks) of questions so far attempted, easy navigation among the questions, etc.

Security is also a matter of concern here to ensure that only authorised terminals are used for the test, only valid users are taking the test, etc. This is a major concern in general, and will be discussed elsewhere.

6.3.4 Evaluating the answers with computer help

As mentioned earlier, automated evaluation is possible for select question types such as multiple choice, match the following, etc. Most testing systems provide support for this. Even here, there are some non-trivial issues. Providing support for negative marks is one of these. Unlike positive marks, which is often just a number for each question, negative marking may follow different schemes. In the simplest case, a wrong answer gets a score which is negative. Potentially, one can associate different negative marks for different options.

If the questions allow multiple answers, the negative marking is much more complex. There are two situations - the student not ticking an option that should be ticked, and ticking an option that should not be ticked. If the negative marking is too slow, ticking all options for all questions may, overall, gain points. If the marks are too high, the negative marks may cost more than the marks allotted for the question.

Automatic assessment of question types such as short answer and essay are research problems still, and hence mostly have to rely on fully manual evaluation. However, a good testing system can provide significant support in the task, highlighting answers not graded, giving indicating comparative analysis of similar answers, etc.

6.3.5 Post assessment analysis

One of the major advantages of doing assessment is the access to a lot of fine grained data on various aspects. One can record number of visits to a question, total amount of time spent on a question, number of times an answer was revised, order of attempting questions, etc during the test. These can be analysed statistically to produce a variety of useful information such as degree of difficulty of a question, discrimination power of question, scoring pattern in the class, etc as well as inputs to content developer and teacher with respect to quality of instruction. A number of statistical methods are available for such analysis (e.g. Chi-square analysis).

7 Communication and Collaboration

In a learning environment, there are different types of communication that can be observed. The primary members of the communication process are the teachers and students.

- **Teacher and Student:** This is a one-to-one interaction as in the case where the student asks a doubt/query and the teacher responds direct to the student. Teacher's feedback and guidance regarding the students' performance is also an example.
- **Teacher and Students:** This is one to many or many to one interaction depending on the source of the communication. Common scenarios include teachers offering clarification on some query to the whole class, announcements about projects/exams, etc.
- **Student to Student:** This is a many to many interaction in general, though sometimes it can be a one-to-one interaction also. Discussions involving groups of students is an example of this. Sometimes these may be guided or moderated by a teacher.

These types of communications form an integral component of any educational environment, and naturally one needs corresponding mechanisms for these in an e-learning environment as well. A classroom-like environment is available for communication using virtual classroom systems such as video conferencing. Students in such environments can raise hands, get an opportunity to voice their doubts which can be heard by all, and the teacher can respond to it, either direct to the student or to the class as a whole. Students can, in general, chat with fellow students or the teacher through a text-chat.

In asynchronous e-learning environments, there are a set of tools provided for meeting the various communication requirements.

- The most common mode of communication is discussion board (also called bulletin board). Users can post queries, announcements, comments, etc on the board, and they become visible to everyone else. Others can comment on them or seek clarification or offer additional inputs. In general, it is a many to many communication forum. Normally, bulletin boards are threaded linking a chain of messages together, and allow users to navigate the space of messages in different ways.
- E-mail is often used when there is one to one communication required or when messages are more urgent (since discussion boards are normally checked less often than mails).
- Sometimes a synchronous text-chat is also used to support effective discussion sessions.

Unlike traditional verbal communication, using electronic media to communicate provide an effective way to record the communications and to share them with other users. This is useful when a teacher is offering clarification to a student, since such information is likely to be of interest to others as well.

One concern in use of these tools is the largely impersonal nature of the communication. The human touch, the non-verbal cues, etc are missing and messages can be misinterpreted. There are netiquette - guidelines - which should be understood and practised to make effective use of these technologies. For example, messages should include emoticons – notations indicating the mood of the sender, such as smiley, expression of surprise, etc – wherever appropriate so that the reader can parse your message in the right spirit.

8 Learning Environments

As discussed so far, an effective deployment of e-learning would address many concerns including content creation, content delivery, assessment, collaboration and communication between faculty and student(s), and among students etc. In addition, support for online assessment would need mechanisms to keep track of marks per student per assessment, and also computing suitably weighted total. A learning management system, LMS, is an integrated application that provides all these and more under one umbrella. With one login, you can see and access all relevant aspects of a course. From an administrative perspective, we would need mechanisms to control access to the course allowing valid students and faculty. Note that, in general, a person can be a student of some subject and a faculty in another. Thus most LMSs today provide a user login mechanism supporting role based access control. You have faculty privileges such as upload content, setup examination, evaluate

submissions, etc for courses where you have a faculty role and student privileges such as view content, answer exams, etc. where you have a student role. Courses where you have no role does not allow you to enter at all.

Most LMSs would also provide user tracking options. These allow you to see when and how often the students log in to the LMS and what they do when they come online, resources any given student has accessed and relevant details, his/her contribution in various discussion forums, etc. These can be constructively used to pull up those who are taking the course lightly, just as the attendance record and class interaction do in a conventional class room.

Together all these provide a fairly comprehensive environment for e-learning just as a college / university campus does in real life. Other optional supports can include fee payment, course planning, blogs, etc.

As you use LMS, you may notice a degree of disconnectedness among the various functionalities. You can not access content from a discussion board, link to the discussion forum from the assignment or assessment, etc. Each component, by and large, stands independent of one another except for their use of a single login.

LMSs so far have evolved as a collection of utilities supporting various functionalities and till now are keeping that approach. As the field begins to mature, a need for deeper integration is being felt and this will get reflected in the future LMSs. This is an active area of research as well since there are interesting challenges in achieving such integration. A relevant example is the integration of chat and email that google provides.

A number of LMSs are available ranging well in functionality, cost, support, etc. Open source LMS like Moodle, Atutor, Claroline, Sakai, etc have large installation base across the world and are mostly quite easy to use. All of these are available free of cost and can be freely downloaded from designated URLs. Thanks to their open source nature, a number of useful plugins developed by other users are also available which offers additional functionalities. Many of these are also available in many languages and one can opt to create a version for any language of ones choice (ref: software localisation).

Commercial system are also available in plenty they often cost a fairly large sum of money as license cost. These can be of the order of 50,000 \$ per year or more depending on the number of student logins required. Commercial products offer better support for fee payment, secure logins, etc. On basic functionalities, you are unlikely to find any significant advantage compared to the open source options mentioned earlier.

9 Getting Started and Roadmap

The discussion so far was meant to give you a feel of the different aspects of e-learning, and highlighting the multiple benefits of adopting e-learning. If that aim has been even partly achieved, the question in front of you now will be: How does one get started in e-learning? In this section, we will make some suggestions in this regard.

As a teacher, it is best to spend some time trying out some of the key components on your own as a pilot activity, before introducing this at an institutional level. The best place to start is by setting up a learning management system as a part of your institute website. If doing this is difficult, you can install the LMS on a computer in your computer lab. Most likely the PCs in your lab are networked as a LAN - then from any PC in the lab, you can access your LMS. Doing this in a lab, prevents users from accessing the LMS from outside the lab, and hence you stand to lose the 'any place' advantage. In all other respects, this is a comfortable and adequate setup.

An open source LMS like moodle or Sakai is recommended. These are quite powerful in terms of features, quite simple to learn to use, supports an incremental learning approach, and have a large user base across the world. These are all freely available on the internet and hence does not cost you financially at least in the initial stages. These LMSs are also well supported by a large developer network where you can get specific technical help. Since these are built as a web application with popular languages like PHP, it is normally easy to get general support on technical aspects locally.

Once the LMS is up and running, you can introduce e-learning ideas step by step gradually building up the richness. Providing additional reading materials, supplementary notes, animation and simulation for difficult topics, etc using the LMS would be a good first step. Posing queries on discussion boards and encouraging open discussion using the LMS would be a good next step, show casing the advantages of this mode of communication. You can then introduce online submission of assignments, review exams setup as tests, wikis and blogs, and so on.

When you have a successful course run this way, introducing the setup to fellow teachers and administration for adoption would be appropriate. The range of content and activities from the pilot course and student responses as seen through the tracking mechanisms would be useful as a case study in this process.

As you mature through this process, you can move deeper into the field. Here are some things you can look forward to:

- Include new models of assessment such as web quest, portfolio, etc.
- Explore additional pedagogy ideas to enhance interaction and activity in the LMS.

- Explore ideas such as adaptive learning, individualised periodic feedback
- Localise the LMS and other software tools, content, etc into a language of your choice.
- Build extensions to capture your institute norms and conventions.

10 Resources

10.1 Useful tools

This list is under construction. Please see the list at the end of the handout for a more extensive list.

- Virtual classroom tools Webex, Interwise, etc are commercial packages available for this.
- Learning management systems Moodle (moodle.org), Sakai (sakai.org), etc are very popular and powerful open source LMSs.
- Content management systems Drupal is a good content management system in open source. You can build powerful portals, etc with this.
- content creation tools Audacity (audio recording and editing), kino (video editing), NYU (HTML page creation), Scribus (page layout and management), etc.

10.2 Content Repositories

- MIT Open Course Ware (<http://ocw.mit.edu/index.html>)
- UK Open University courseware – Openlearn (<http://openlearn.open.ac.uk>)
- Project Gutenberg
- Wikipedia
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