Pergamon

Internet and Higher Education
4 (2002) 287–299

THE INTERNET AND HIGHER EDUCATION

Successful implementation of e-Learning Pedagogical considerations

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Abstract

Many institutions of Higher Education and Corporate Training Institutes are resorting to e-Learning as a means of solving authentic learning and performance problems, while other institutions are hopping onto the bandwagon simply because they do not want to be left behind. Success is crucial because an unsuccessful effort to implement e-Learning will be clearly reflected in terms of the return of investment. One of the most crucial prerequisites for successful implementation of e-Learning is the need for careful consideration of the underlying pedagogy, or how learning takes place online. In practice, however, this is often the most neglected aspect in any effort to implement e-Learning. The purpose of this paper is to identify the pedagogical principles underlying the teaching and learning activities that constitute effective e-Learning. An analysis and synthesis of the principles and ideas by the practicing e-Learning company employing the author will also be presented, in the perspective of deploying an effective Learning Management Systems (LMS). © 2002 Published by Elsevier Science Inc.

Keywords: Pedagogy; Learning Management Systems; Learning Content Management System; Learning objects; Quality of content; Formative assessment; Summative assessment; Instructional design model

1. Introduction

'K-economy' is a buzzword frequently used by people from all walks of life. How would the advent of K-economy affect the work setting? Among other things, this inevitable shift from a product-based economy to a knowledge-based economy would result in an increased

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1096-7516/02/$ – see front matter © 2002 Published by Elsevier Science Inc.
PII: S1096-7516(01)00071-9

demand for knowledge workers who are capable of higher-order thinking and reasoning in solving intricate and authentic problems in the work place. This change would necessitate organizations to educate and train anyone, anytime, and from anywhere. Thinking along this line brings to mind yet another term that is prefixed with the ubiquitous 'e': e-Learning.

However, the imperative today is not the mere access to knowledge, but timely access to relevant and useful knowledge. The real value of e-Learning lies not in its ability to train just anyone, anytime, anywhere, but in our ability to deploy this attribute to train the right people to gain the right skills or knowledge at the right time. Only then can e-Learning yield a justifiable return on investment (ROI) considering the costs incurred in implementing e-Learning. In order for the implementation exercise to yield a justifiable increase in revenue for an organization, employees must yield a significant increase in productivity as a direct result of the implementation. This in turn would depend on whether or not the appropriate employees are learning the right information at the right time. All this can be achieved only by adhering to underlying pedagogical principles that are imbedded in the e-Learning experience.

2. Pedagogical principles for e-Learning

Essentially, e-Learning is another way of teaching and learning. In its broadest definition, e-Learning includes instruction delivered via all electronic media including the Internet, intranets, extranets, satellite broadcasts, audio/video tape, interactive TV, and CD-ROM. All efforts to implement e-Learning will eventually move towards total automation of administrating the teaching and learning processes by means of a software known as Learning Management Systems (LMS). e-Learning is a fairly recent phenomenon but the underlying pedagogical principles (Bixler & Spotts, 2000) have not been included. Most of the pedagogical principles that apply to the traditional classroom delivery method also apply to e-Learning. However, these principles need to be extended to accommodate and provide for the rapid changes in technology. Pedagogical principles must form the very basis for inclusion of features in LMS. Better still, these principles should be integrated into the LMS where every feature included is accompanied by explicit guidelines on the best method of their use to effect pedagogically sound instruction.

A recent search (December 2000) on the Internet for an LMS that incorporates pedagogy in the design of the software did not yield any fruitful results. Most LMS vendors deliberately distance themselves from pedagogical issues, often adopting an indifferent attitude or sometimes even trying to disguise it as a praiseworthy act of impartiality. This finding is coherent with Firdiyiyek's (1999) argument that there is a serious mismatch between the abundance of features in LMS and the lack or total absence of explanation on the pedagogy underlying the inclusion of these tools. Also lacking are guidelines on how to design, develop, deliver, and manage pedagogically sound e-Learning materials. This is a clear indication that most LMS providers perceive themselves as mere providers of technology. Consequently, while every technologically possible feature is included in LMS, there is an absence of overt pedagogical integration. Vendors of LMS often contradict

themselves. On the one hand, they claim that they can only provide tools for e-Learning, but cannot tell educators how to use these tools to teach; while on the other hand, they boast of their ability to provide ''complete e-Learning solutions.'' e-Learning cannot continue to exist without pedagogical techniques, nor without incorporation and consideration of the domain-specific knowledge.

The current situation poses a serious challenge to any organization embarking on implementing e-Learning. Often many features and tools of LMS are left unused. This is a terrible waste of resources since these tools account for the cost of implementing e-Learning. In a worse case scenario, the tools may end up being used in a manner entirely opposed to pedagogical principles, and in turn, will hamper learning. In either case, the impact inevitably will be reflected in the return on the e-Learning investment.

Pedagogical principles are theories that govern the good practice of teaching. As far as e-Learning is concerned, the good practice of teaching or instruction is well represented in an eclectic linking science known as Instructional Technology. It is a growing science because various elements of the good practice of teaching are still in the process of being discovered by means of trial and error. Luckily, some of these trials and errors have become subjects of funded research, the results of which have been documented and made available on the Internet. One such research project was conducted by the Institute for Higher Education Policy, USA. The research draws upon the experiences of pioneers in e-Learning comprising of six institutions of higher education in the US. The deliverable from this extensive study is a set of quality benchmarks distributed along seven parameters (Quality on the Line, 2000). The seven parameters are:

- Institutional support
- Course development
- Teaching and learning
- Course structure
- Student support
- Faculty support
- Evaluation and assessment

The desirable attributes that should characterize an e-Learning environment will be discussed in this paper, drawing upon the underlying pedagogical principles, the findings of the Quality on the Line study, and through reflecting on personal experiences where it is possible.

3. Desirable attributes of an e-Learning environment

As stated earlier, in order for any e-Learning implementation exercise to be successful, it must be rooted in strong pedagogical foundations. In Sections 3.1–3.5, pedagogical attributes will be discussed along five parameters: developing content, storing and managing content, packaging content, student support, and assessment.

Table 1
Instructional development methodology for development and evaluation of e-Learning content

Phase	Step	Purpose	Activities	Deliverables
Analysis	1. Learner analysis	Identify characteristics of learners	• Define minimum academic qualification target learners should have. • Define personal and social characteristics of learners. • Describe specific entry characteristics of learners.	Learner profile
	2. Task analysis	Determine level of detail and depth of content	• Make a list of general topics to be covered by instruction. • Outline the course content. • Identify the tasks learners should be able to perform. • Elaborate task into subtasks.	Task sheet and information flow chart
Design	3. Defining instructional objectives	Write instructional objectives according to Mager's Format	• Analyze tasks to identify conditions, performance, and standard of performance. • Consolidate the components to write objective statements. • Identify terminal objectives, intermediate objectives, and enabling objectives.	Instructional objectives
	4. Selecting instructional strategies	Select instructional activities and media elements	• Analyze instructional objectives to identify types of learning involved. • Match instructional objectives with Gagne's nine events of learning. • Identify macroinstructional strategy. • Identify instructional activities. • Select media elements and rationalize selection.	Plan on how to achieve instructional objectives

Production	5. Preparation of first draft material	Produce draft material	• Construct a concept map. • Develop and validate Course Evaluation Questionnaire. • Create storyboards. • Transform storyboards into instructional product.	Draft instructional material
Formative evaluation	6. Review by content expert	Gather information about weaknesses and revise draft material	• Administer Course Evaluation Questionnaire (Part I) to content experts. • Revise instructional material.	Revised instructional material
	7. One-to-one trial	Gather information about weaknesses of the material	• Site visit • Select three learners, one high achiever, one average learner, and one low achiever. • Observe the learners' behavior as they interact with the instructional product and respond to items in Course Evaluation Questionnaire (Part III).	List of amendments required to improve the material
	8. Small Group Trial	Gather information about weaknesses of the material	• Site visit. • Select a sample of ten learners equivalent to and representative of the target learners. • Administer the Course Evaluation Questionnaire (Part II) as they interact with the instructional material.	List of amendments required to improve the material
Production	9. Production of the first version of the e-Learning module	Produce the instructional material	• Analyze feedback gathered. • Revise instructional activities, media elements, interface design. • Produce the first version of the material.	First version of the e-Learning module

3.1. Developing content

Implementation of e-Learning in any organization means reconstituting roles for faculty members. In most cases, faculty are expected to undergo immediate transformation and become e-Learning content developers. Faculty members cease to exist as mere instructors, and often are forced to assume the role of content experts, instructional designers, graphic artists, media producers, programmers, and instructors. No wonder they resist any attempt to implement e-Learning! After all, who would want to perform six jobs and get paid for only one?

These strong statements do not mean to imply that instructors cannot be transformed into e-Learning content developers but they must be amply enabled with the right knowledge and be given a reasonable amount of time to transform. Even then not everyone can perform each and every task of developing e-Learning content. A rare few, often those who find the opportunity to learn something new exciting, will emerge as capable content providers for their own specific knowledge domains. The e-Learning environment must encourage instructors to form teams by adopting tasks they find themselves best suited for. These individuals can then be collectively assigned to develop content.

Faculty members should be rewarded for engaging in content development activities. The reward need not be monetary. For example, organizations can introduce content development competitions. More importantly from the very first day, steps must be taken to prevent faculty members from regarding content development as a punitive bane.

Minimum standards must be stipulated and all e-Learning content must meet the minimum standards that are established. In order to achieve this, the content development process must adhere to a systematic Instructional Development Methodology like the one displayed in Table 1. Consistently using a systematic approach to develop content would ascertain the congruence of the learning material with the predetermined learning objectives.

The methodology presented in Table 1 appears to be linear but it is actually iterative in practice. All the functions interact with one another and content development teams will often find themselves moving back and forth repeatedly between the functions. Sometimes plans are finalized for one function but after moving on to the next function, decisions that need to be made for the current function may limit, elaborate, or alter the decisions made for the previous function. For example, the decision to adopt a discovery strategy for instruction may deem the earlier decision to limit the material to pure HTML pages an unlikely one.

e-Learning content must be designed and developed in smaller manageable chunks known as learning objects (LO). LOs are the small units or building blocks of instruction that can be taken as stand-alone units of instruction even when it is not embedded within a larger structure of content. Due to its smaller granularity and the way it is programmed, tagged, and stored, LOs have increased share-ability and reusability. As far as LOs are concerned, technological descriptions of how an LO is coded, tagged, and stored are more easily available than pedagogical descriptions of what data and how much data should go into a single LO.

Until recently, Lego blocks were commonly used as an analogy to LOs. According to Wiley (2001), using Lego blocks as a means of explaining LOs was too simplistic and should be avoided. Lego blocks are also distinctly different from LOs because:

- Any Lego block can be joined with any other Lego block
- Lego blocks can be assembled in any manner
- Assembling Lego blocks are simple for children to assemble

Alternatively, Wiley suggests atoms as a more likely metaphor for LOs. The atom is a much better candidate to explain LOs than Lego blocks because, like Lego blocks, atoms are small things that can be put together to form larger things. However, atoms are unlike Lego blocks because:

- Not all atoms can be combined with every other atom
- Atoms can only be assembled in a certain structured manner determined by the internal structure of the atom itself
- Special training is needed in order to assemble atoms

A personal working definition of LOs adopted by the author is one that regards LOs as e-Learning's equivalent to traditional classroom lessons. It is one chunk of relevant information that learners can access and internalize in one sitting. Like an atom that has smaller components (electrons, protons, and neutrons), the LO also would comprise of several smaller components.

The gateway to an LO is a prerequisite test that determines whether or not the learner possesses all the prerequisite skills in order to understand the content of the LO. If the learner does not achieve the minimum scores stipulated by the LO, then the learner will be directed to a more basic LO that teaches all the prerequisite knowledge required to master the current LO. If the learner meets the minimum requirements to learn the current LO, then the learner will be put through a second set of test questions known as pretest to determine whether the learner needs to take the whole of the current LO, only part of it, or can skip it altogether. If the learner is allowed to take the current LO, then the learner is taken to the heart of the LO, the content presentation frequently interspersed with practice items. This is finally followed by a posttest that assesses the learners' mastery of the LO's knowledge. Then the learner is directed to the next LO in sequence.

3.2. Storing and managing content

Having built LOs, LOs must be assigned a shelf life predetermined based on the LO's classification category. LOs belonging to technical categories like programming should be assigned a shorter shelf life compared to LOs on soft skills. Upon expiration of the assigned shelf life, the LO must be taken off the shelf. A system must be put into place to manage the publishing workflow of content. The system should include alerting the author that the LO has outlived its shelf life. Subsequently, the LO can be sent to a committee to be reviewed, updated, and revised and sent back to the storage repository to start the next cycle of its shelf life.

The LOs must be tagged with metadata that will later help the process of searching and locating a particular LO. The metadata should include details like name, author, date, job, skill, version, date last revised, etc., so that it may be easily searched by users (Singh, 2000).

3.3. Packaging content

Learners and instructors should have the option to access and offer content in the form of bare LOs for 'just-in-time learning'. 'Just in time learning' from individual LOs may be the best option to bridge specific performance or knowledge gaps. Alternatively, instructors can offer and learners can sign up for whole courses that are scheduled to run over a fixed duration of time. This type of learning can take place when the learner is seeking personal development or career progress. Courses are structured by combining a number of LOs. The LOs can be retrieved from the central repository and assembled into a course if they have all the inherent characteristics to allow the integration.

3.4. Student support

Student support is one area of e-Learning that is markedly different from the traditional classroom delivery method. In traditional classroom instruction, student support can be addressed on a supply-and-demand basis. When a student needs performance support they would communicate their needs explicitly and consequently receive the needed support. In e-Learning settings, where students learn as a result of interaction with programmed instructional systems, all possible types of problems student are likely to face have to be foreseen in advance in order to introduce features for performance support. One way of doing this is by using a framework based on Laurillard's Conversational Theory. This theory advocates a teaching strategy based on interaction between teacher and student; not on the actions required of the student by the teacher. The theory also emphasizes the need for constructive and meaningful feedback. Students should be allowed to reflect as they interact with the learning material (Laurillard, 1996). Students' rate of access should be tracked and the information used to distinguish between high achievers, average learners, and slow learners. This information can then be used to motivate or positively reinforce learners.

3.5. Assessment

Assessment is an indispensable part of teaching and learning. Essentially, it is assessment that reinforces the learning approach a student adopts. If a student is often tested on higher-order thinking skills, they are likely to adopt the desirable deep holistic approach to e-Learning. On the contrary, if students are tested on lower-order thinking skills, they would probably be encouraged to practice the undesirable surface atomistic approach to learning (Twomey, 1996). Despite its importance, assessment is constantly feared by educators and is short-changed by instructional designers (Horton, 2000). When Horton mentions educators discounting assessment, he probably means the various assessment malpractices that exist from the lowest levels of educational institutions to the highest. This problem is even more

serious in the e-Learning environment because instructors who are already burdened with their new role in the e-Learning setting are likely to succumb to the convenience of using automatically scored question types for assessment.

Most LMS provide templates for multiple-choice questions (MCQ), true/false questions (TFQ), matching questions (MQ), or short answer questions (SAQ). However, essay questions, projects, assignments, and case studies have been totally omitted, yet this should not be taken to mean that these forms of assessment are not needed to perform valid and reliable assessment. This discussion will become more meaningful if we consider the two different forms of assessment.

Assessment is typically divided into two types, namely, the summative assessment and the formative assessment. Summative assessment is used to grade students to demonstrate students' achievement and it involves making a final judgment of the students' achievement relative to the predetermined objectives. Formative assessment is used as a diagnostic tool for students and teachers to identify and improve areas of weakness (Williams, 2000). It is a common belief that MCQ assessments are not a valid means of testing the broad range of cognitive skills students are provided with especially in higher education. An MCQ supposedly works best only to assist memorization. Actually, a carefully designed MCQ can be deployed to assess learning even at the highest level of *Bloom's Taxonomy of Educational Objectives*. Table 2 shows that among the different types of items supported by most authoring shells, MCQ is the only type found suitable to assess learning throughout all the six levels of the *Bloom's Taxonomy of Educational Objectives*.

Use of MCQ as the only means of performing summative assessment of the learners is not advisable since there is a chance of learners scoring in such assessments through guessing at the correct answer and not as a result of profound understanding of the subject matter. However, MCQs are still a boon for e-Learning because carefully designed MCQs can help learners to acquire an in-depth understanding of content. For instance, a student who wishes to improve his mastery of the concept Photosynthesis can use the search function to locate all questions in the question repository that revolve around this concept. He can then work on as many questions as he likes until he has mastered the concept.

Table 2
Suitability of item types to measure different levels of cognitive ability

Bloom's cognitive level of skill development	MCQ	Text entry	Matching	Case studies	Simulation
Knowledge	Yes	Yes	Yes	No	No
Comprehension	Yes	Yes	Yes	Yes	No
Application	Yes	Yes	No	Yes	No
Analysis	Yes	No	No	Yes	Yes
Synthesis	Yes	No	No	Yes	Yes
Evaluation	Yes	No	No	Yes	Yes

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MCQ items that test higher-order thinking and skills are difficult to construct. They may only be mastered after a lot of practice and time. Educators should continuously improve themselves to be able to use technology purposefully in order to improve learning. Hence, time spent on mastering the art of designing multiple-choice items capable of testing higher-order thinking and skills would indeed be worth the time and effort; all the more so when considering their benefits in terms of automatic grading and speed of feedback (Peel, 2000). In fact, blaming the limitations of technology as a hindrance in using MCQ to test higher-order thinking is an inadequate excuse.

4. Impact of not adhering to pedagogical principles

In the course of these pedagogical considerations, it has become clear that the impact of not considering the underlying pedagogical principles when implementing e-Learning will undermine the implementation process. Among other things, it will result in faculty members resisting the change, learners staying away from the e-Learning courses, poor performance of learners, and poor quality of content. Hence, at this point, it is important to stress that any e-Learning implementation exercise must take into account the underlying pedagogical principles. These impacts will be revisited and integration of pedagogical principles in LMS is discussed.

5. Integrating pedagogical principles into LMS

An important step that must be taken prior to implementing e-Learning is selecting a suitable LMS. Often LMS are compared and evaluated on the basis of feature richness. The more the features of an LMS, the more likely it is to be chosen. This form of uninformed decision-making on the part of LMS customers positively reinforces vendors' inclusion of every technologically possible feature in an LMS. It is time for consumers in the LMS market to make demands on the vendors for products to have fully integrated pedagogy. This change has begun to take place but it is still at its early stage of being affected. In the next sections, the author synthesizes some forms of pedagogical integration in LMS that are prerequisites for successful implementation of e-Learning.

6. User profiles

Most LMS, despite being heavily laden with features, address only three groups of user profiles. These three groups of users are administrators, learners, and instructors. Features related to content development are consolidated under the tools for instructors, hence, implying that the tools provided and consequently the tasks pertaining to content development are the responsibility of the instructors. This implication can make implementation difficult because it does not depict the gradual stages of expanding the instructors'

responsibility. Furthermore, this may lead the organization to believe that content development is the most natural thing that every instructor should be able to do without any form of training. Ideally, the tools should be grouped and packaged under different categories of user profiles so that the actual number of people involved in performing content development work is well represented. LMS should group the tools into various suites of user profiles like content experts, instructional designers, developers, etc.

7. Content development

Interfaces used for development and uploading of content must clearly communicate the necessity to develop content adhering to the instructional development models. The interfaces should also communicate the need to develop content at smaller levels of granularity to promote share-ability and reusability.

8. Collaboration and coauthoring

Standard communication formats must be included to supplement the communication tools that are currently included in almost all LMS. These formats can take the form of structured instruments where users need only to key-in words or phrases. All the information categories must be specified and elaborated by the instruments so that the users do not have to waste a lot of time and effort in information logistics.

9. Content publishing workflow

The publishing workflow must communicate the necessity for a proper evaluation–deploy–review–revise cycle. The system should include structured instruments to help administrators generate text-based communications with other users of the e-Learning network with regard to the shelf life of content. It would be better still if this notification process is automated. This is very important for organizations dealing with very time-sensitive domain areas.

10. Assessment

Most LMS include test builder tools that automate the process of authoring questions. Most of these tools offer easy-to-use templates for authoring automatically scored questions like MCQ, TFQ, SAQ, and other forms of SAQ and MQ. These tools do not mention other types of questions that can be used to assess learners like essay questions, projects, structured subjective questions, and case studies. The developers of current LMS were probably driven by technology in choosing the question builders to be included in the system. Creating quiz

questions, possible answer options, assigning weights to the answers, automatically scoring the answers, and programming appropriate feedback for different answers provided by learners require a working knowledge of HTML, Java Script, and other programming languages. This is definitely too much to expect of instructors, therefore, the developers of the LMS probably felt it was necessary to provide instructors with these tools.

On the other hand, in order to assess students by means of projects, case studies, assignments, and other artifacts of learning, all an instructor needs to do is to post the message on the bulletin board. Students then complete their assignments and submit their work to the instructor via e-mail or upload it as a web page for the instructor to assess manually. Instructors with basic computer knowledge will be able to do this. Assuming this is the underlying consideration that led to the inclusion of the quiz builder templates, the developers' good intent deserves appreciation but their choice of tools in putting their good intent to practice could be improved.

This decision may have some negative implications pedagogically. The prominence and convenience of the builder tools may imply that the use of only MCQ, TFQ, MQ, and SAQ are valid and reliable means of assessing learning. Similarly, the total omission of essay questions, projects, assignments, and case studies may imply that these forms of assessment are not needed to effectively assess learning. In some cases, instructors who are fully aware of the strength of the other assessment types having found their way into the test builder tool may not know how to go about creating and administering these assessment elements.

11. Resource management tools

Can any organization implement e-Learning completely? The answer is a definite 'no' because not all types of content lend themselves well to the electronic delivery mode. Some knowledge types need to be complemented with practical training. Some knowledge is acquired best in a face-to-face session with the instructor using paper-and-pencil exercises. Just because e-Learning is available, the old practices cannot be totally discarded. The old and new have to be mixed and blended in the right proportions to provide a rich and fulfilling learning experience for the learners. Hence, the need for the resource management tools to manage the scheduled use of training rooms, laboratories, computers, equipment, or even trainers.

12. Conclusion

This attempt to provide a pedagogical foundation as a prerequisite for successful e-Learning implementation has clearly changed the emphasis from merely managing the logistics of electronically delivering e-Learning content, to managing e-Learning content. Some of the demands expressed have already been fulfilled in a new generation of e-Learning solutions known as Learning Content Management Systems (LCMS). The vendors of Kaleidosckop claim that it is an LCMS built not only on a strong pedagogical foundation,

but also with the purpose of helping educators manage this wave of change called e-Learning. In fact the developers welcome comments, opinions, and even SOS calls which they promise to take seriously. Educators with any level of experience in e-Learning, who would like to share comments (good or bad) with the developers, may write to them at info@kaleidoscko-op.com. Let's see if our grouses are heard and translated into meaningful integration of features in future updates! If more educators come forth to express their expectations of e-Learning solutions, their voices would collectively become loud enough to be heard by the e-Learning solution providers. The subsequent change is inevitable!

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