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The E-Learning Challenge

AT THE ONSET of this new millennium, in the advanced societies now called *postindustrial* societies, most employees are *knowledge professionals.* This fact tells us that the information available to us will grow exponentially in the future. This imminent growth will also be fueled by the 200 million Internet users who spend a substantial part of their time researching and producing new information on electronic networks; communicating and sharing without borders; and exchanging data, texts, pictures, and sounds ever more rapidly.

Given this massive flow of new information—a fruitful source for new knowledge—and the activities of knowledge workers that are modifying the very nature of work and creating an enormous need for information and for highly effective methods for turning that information into knowledge, we need to ask how long traditional training and educational models can continue to prevail.

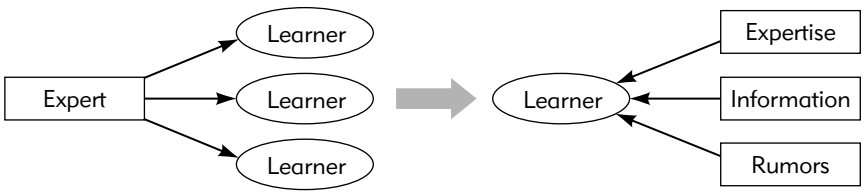
To answer that question, this chapter discusses the developing knowledge society and the rapid increase of Internet technologies and considers the impact of these changes on training needs. It then presents an overview of

technology-driven, pedagogical (*techno-pedagogical*) models for e-learning, the processes that govern the development and management of an e-learning system, and the system actors and the technological resources that support them. The chapter concludes with a survey of the e-learning delivery tools and systems current at the time this book was written.

The Knowledge Society

A striking phenomenon associated with the development of the knowledge society is the shift that is occurring in the traditional education paradigm, as illustrated in Figure 1-1. The tradition in most educational institutions and in workplace training is that learning originates from a trainer or a professor who is the learner's main source of information and expertise. The professor or trainer prepares the course, selects the instructional materials and activities, and lectures and coaches the learners, who in turn solve problems and complete exercises, assignments, and projects.

Figure 1-1. An Education Paradigm Shift.



We are now witnessing a radical shift of this traditional paradigm. It began four decades ago with the ubiquitous arrival of television. Today, owing to the exponential growth of information and its availability to anyone anywhere on communication networks, everyone is becoming a lifelong learner.

Learners with easy access to what others know are exposed to many sources of information and expertise. They are also exposed to rumors and unreliable information. This means they must be able to select and integrate information from various sources in order to compose a coherent and useful synthesis for their work or social activities. In short, today's learners have to

develop, with minimal help, abilities and knowledge superior to those of the past. They must select, process, and use the right information to communicate. Are we aware of the complexity of this task? Not only are learners faced with a rapidly increasing quantity of information and knowledge but they are also required to differentiate what is useful and valid from the not useful and inaccurate in that mass of available information. Traditional education does not train us to accomplish these tasks. Instead, as the Québec Council for Higher Education has recently stated (in light of the discussions held at many international conferences on education and learning since the beginning of the 1980s[1]): "Special attention must be given to superior cognitive capacities (aptitudes, action planning, reasoning and problem solving) and social abilities (autonomy, communication and collaboration capacities). These abilities are those sought by employers to take [into] account the impact of ICT [information and communication technologies] on the employment market."[2]

What we actually have today is not yet a knowledge society but an information society. We hope that it will become a real knowledge society. This can happen only if our education and training emphasizes the abilities that allow us to process intelligently the facts, data, and information we encounter both at work and in our daily lives. From a more general perspective, important social contradictions are developing: the globalization of the economy tends to reduce national, linguistic, and cultural diversity while centralizing power among large, private corporations; the gap continues to widen between the rich and the poor, between the educated and the uneducated, between those who master the new means of communication and those who do not have access to them. These complex problems offer major challenges. Learning models, methods, and tools must be improved. Before we can have a knowledge society we must have a knowledge revolution that results in the intelligent use and the mastery of learning technologies by the largest possible number of people.

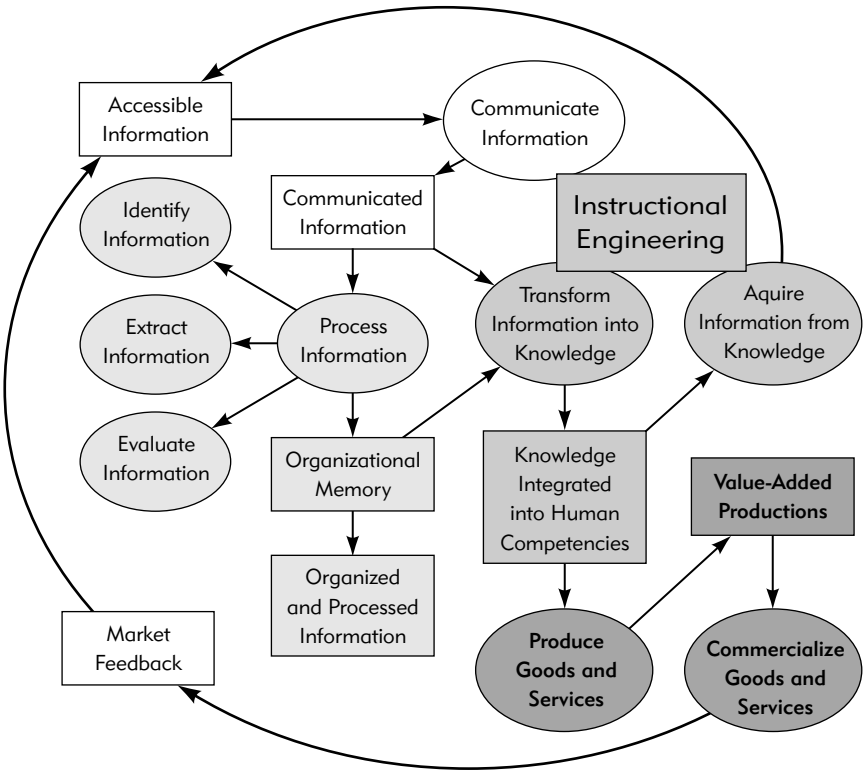
Knowledge Management

Knowledge directly affects the competitiveness of corporations. It is not surprising that corporate managers are receptive when theoreticians stress the importance of managing their companies' knowledge. For example, a full

decade ago Peter Drucker suggested that the future belongs to corporations who know how to strategically exploit their knowledge, claiming: "knowledge is now the decisive production factor."[3] This type of discourse has been rapidly embraced. A Delphi Group knowledge management study involving 500 organizations found that the percentage of these corporations that had started initiatives to manage knowledge within their organizations grew from 28 percent in 1997 to 51 percent in 1998, that is, in only one year.[4]

Figure 1-2 illustrates the knowledge management process in a corporation. Beyond the information cycle present in every organization, more and more often management has an increased interest in developing new processes that facilitate the transformation of information into knowledge. The new knowledge, skills, and competencies acquired by the staff allow the organiza-

Figure 1-2. The Knowledge Management Process.



tion to improve the quality of its products and services, thus securing an advantageous position in a competitive market.

These new processes go well beyond the computer management of data or documents. They aim to secure the knowledge held by the organization's experts. The experts' knowledge is then documented, pooled, and reused by the other organization personnel through information, training, and performance support systems. Although such processes have always been informally present in organizations, the new awareness of their importance is leading organizations to reengineer their work processes using new technological tools. The result is improved, formal development of new knowledge, principles, methods, models, and strategies to deal with the competitive market. This new phenomenon, in contrast to the simple consultation of information in databases, puts much more emphasis on employee knowledge and competencies, because higher-level knowledge requires acquisition and maintenance processes that can be learned only through informal and formal training activities that are continuous, accessible, and effective.

Instructional engineering plays a crucial role in designing and delivering education and training that meets learners' new needs whether these learners are in school, a corporation, a department, or some other kind of organizational entity. Instructional engineering plays a crucial role. Instructional engineering is what designers do as they build and maintain global learning systems that focus on engaging learners in two main processes:

1. *Knowledge extraction,* the process of transforming the knowledge of an expert in a given field into structured information, which is subsequently made available to the whole organization
2. *Knowledge dissemination,* the process of transforming information into knowledge that is internalized by the learner as new competencies, typically ones useful to the learner's organization

Pedagogy and Technology

The use of new learning technologies such as educational software, multimedia, and the Internet is growing rapidly in both North America and Europe and even in developing countries.

Since the Internet and the new training technologies became widely available in the middle of the 1990s, e-learning has been growing rapidly. Network (Internet and intranet) and CD-ROM technologies are increasingly replacing more traditional training methods. In addition, most observers recognize that Internet and intranet training is tending to supplant multimedia education provided on CDs.

The world market for workplace e-learning was evaluated by many studies as being only $US 2 billion in 1999. According to Deloitte Consulting[5] and W. R. Hambrecht[6] independent studies, companies in all countries expect to increase their e-learning expenses from $US 3 billion in 2000 to $US 12.5 billion in 2003. This total could increase to $US 18 billion in 2005, according to the most recent estimate by IDC.[7] These estimates from various sources converge. The trends are constant, leading to a situation where e-learning would account for more than half of all kinds of workplace training.
In the public education sector, in universities and colleges as well as K-12, the same enormous growth is noted, as shown in Table 1-1.

Table 1-1. World Trends in E-Learning, by Sectors, in $US Billions.

	2001	*2003*	*2005*
Enterprises	3.5	7.0	21.0
Colleges and universities	2.0	7.0	15.0
K-12	1.5	6.0	12.0

Source: Giga Information Group (http://www.gigaweb.com/).

In the area of public education, where until recently instructional engineering and technological course delivery systems were seldom perceived as significant, universities are directing some energy toward e-learning and the new training technologies. In the United States, a recently published survey indicates that in 2000–01 over half of the postsecondary institutions offered distance courses.[8] From 1995 to 1998, the number of distance courses dou-

bled in the United States, totaling 52,270 courses offered to 1.6 million students. On the international level the number of Internet courses offered is growing rapidly as well, creating new needs for design and delivery tools and methods in both public and private educational environments.

This new pattern recognizes the vital importance of training and also that today's training must do more than traditional training, as is suggested by several experts on organizational practice. For example, in his book *The Knowledge-Enabled Organization,* Daniel Tobin claims that the majority of current organizational training does not lead to measurable improvements. Rather than use traditional approaches centered on the transmission of information in a classroom, he recommends employing a new paradigm of continuous construction of knowledge and competencies.[9]

We must recognize the revolutionary potential of new educational technologies. In the past, education was centered on the expert, the master, sharing his or her knowledge or know-how with a great number of students. In contrast, newly implemented interactive resources place the learner at the center of the educational environment and greatly reduce the time devoted to lecturing activities. This invites the trainer to change roles, defining himself or herself as an instructional designer and, more generally, as a facilitator, a motivator, and a coach.

Through e-learning, educators and trainers are beginning to mobilize technologies for knowledge and higher-level skill acquisition—and not mainly for entertainment, as has become largely the case with television. We may yet hope that the interactive communication fostered by the Internet will be in contrast to the passivity fostered by television. In much e-learning, learning events centered on competencies to be acquired can be available at any time and at any place. Through these learning events individuals can immerse themselves in learning activities and even select personalized scenarios, thus developing their aptitudes to *learn how to learn.*

All this potential can be mastered and channeled only through the implementation of instructional principles that although well represented in theoretical writings have not been effectively available for educational practitioners until recently. Now the advantage of allowing the learner to

construct knowledge is no longer a theory but a fact experienced by an increasingly large number of Internet users. With the ability to access and use multiple sources of information and expertise at any time and any place through television technology, CDs or DVDs, and Internet networks, the learner acquires knowledge in many ways. The educational potential of these multimedia technologies lies not only in the multisensory integration and interactivity they offer, but first and foremost in the education paradigm shift they represent, from the transfer of information by the instructor to the construction of knowledge by the learner.

The shift from traditional lectures to e-learning using the new training technologies requires a transition strategy, one that gives people and organizations time to adapt to the new methods and training tools. The best training is that which meets the knowledge management needs of the organization and of the learners. Here again instructional engineering techniques are essential, defining the most adequate technological models and the bridges that need to be built between the training of today and that of the future.

Network-Based Learning Models

The world of education is bubbling with techno-pedagogical ideas. With the extremely rapid growth in multimedia telecommunications, e-learning models are proliferating, as are development tools and delivery platforms.

The term *e-learning,* or *distance education,* now covers several very different techno-pedagogical realities, ranging from simple multimedia integrated into a traditional classroom to complex, interactive multimedia models that make learning available at any time and in any place. I have classified these teaching models under six paradigms: the high-tech classroom, the distributed classroom, hypermedia self-training, on-line training, the community of practice, and the performance support system. The following sections analyze their potentials and limits, examining a series of qualities every e-learning system should possess. I focus here on the "pure" models. The integration of these models into a more complex architecture is discussed in the following chapter.

High-Tech Classroom

The *high-tech classroom* is simply a traditional classroom where a number of technologies are permanently installed and used. These include sophisticated multimedia equipment, computers linked to a local or wide area network, and an electronic projector for presentations or Internet demonstrations. A videoconference system may be installed on classroom workstations. A bidirectional link may be provided so classroom presentations can be accessed by individuals outside the classroom (remotely located). In other words, the classroom is open to external information, but classroom offerings and that information are not necessarily distributed in several places.

These classrooms are often called *multimedia laboratories.* Now, as high-tech equipment spreads to many classrooms and other training locations, the term *electronic campus* is coming into vogue.

At some schools and institutes of higher education, advantageous financing plans encourage students to purchase notebook computers they can use in these classrooms, thus benefiting from the broadband networks and other equipment installed on the premises. Moreover, they can also use these computers as training tools outside the classroom.

Distributed Classroom

The *distributed classroom* is a virtual high-tech classroom, one spread over several distant locations.[10] These locations are equipped with a videoconferencing system and a variety of peripheral equipment connected to a computer: cameras, voice sensitive microphones, videocassette players, and CD or DVD readers. The learning events are presented live by a professor or trainer, who delivers a lecture using a variety of instruments. In this model the students and the instructor are all present at the same time in their different rooms, linked through telecommunications. The communication is mainly one-way, from the instructor to the learners, although the learners have access to ways to ask questions and communicate with others in other rooms. Also, if all the rooms are identically equipped, the learners may use the system for seminars in which they are invited to present to each other work they have produced for the course.

There are several varieties of distributed systems. For example, some deliver the presentations to each student's workstation rather than to a single screen viewed by all the participants present in the room, thus enhancing the interaction possibilities. Several universities and companies now use a distributed classroom system to deliver training off campus and in company offices spread throughout several countries.

Hypermedia Self-Training

Hypermedia self-training[11] favors individual learning. The term *hypermedia* refers to the hyperlinks that allow the learner to browse in a network of pages and other external resources viewable on the computer screen. The learner, working alone, accesses this network as prepared multimedia documents on the Internet, or on CD or DVD for audiovisual materials that require too much bandwidth to be viewed efficiently. The instructional material can then be entirely local (on a CD or downloaded on the workstation), on-line with audio or video streaming via the Internet, or a hybrid, part local and part on-line. Although some hypermedia material can be viewed only from one page to the next, the learner's progression through the contents of this network is typically not linear. Thus the student not only can progress at his or her own pace but also can follow a flexible course plan, using the hyperlinks that appear most relevant considering his or her current or target knowledge. Self-training entails the complete absence of tutoring by a trainer. Also, there is no imposed collaboration between learners. Hence there are no place or time constraints imposed by the training model.

Since the arrival of the Internet, thousands of hypermedia courses have been published on the Web, and this number continues to increase daily. The training portals maintained by educational organizations grant access to series of such courses and programs and also various support services that constitute the basic elements of a virtual campus (this topic is discussed in more detail in Chapter Two).

On-Line Training

On-line training[12] also uses the Internet, multiple media, and hyperlinks but in an extremely different way. It is managed by a trainer delivering presentations to a dispersed group of learners and coordinating their remote inter-

actions, mostly in an asynchronous mode; that is, the participants are not expected to be present simultaneously. The learners can thus progress at their own pace, interact between themselves, and use the instructional materials between the stages defined by the instructor. During each stage, the pace of the activities and most of the content of the exchanges are managed by the instructor. He or she will allocate, for example, three weeks for a module, launch a discussion, suggest work to be done, and then act as an adviser and content expert until the following module.

In this model the main technological tools are those that can be used in an asynchronous mode: newsgroups, e-mail (for private communication between the learner and the professor, tutor, or trainer), and file transfers (for exchanging documents and evaluating assignments). This model has been used for at least fifteen years in such distance or open universities as the Téléuniversité du Québec and the British Open University and is increasingly being employed on university campuses all over the world, where it becomes a practical alternative to classroom education.

Community of Practice

Communities of practice[13] may use the same asynchronous communication tools as those used in the on-line teaching model and may also at times use tools for real-time communication, such as audio- or videoconferencing on a workstation or in a classroom. The main characteristic of this model is communication and discussion among the members of a group of specialists centered on a common task—for example, learning how to use training technologies or solve specific medical problems. There is no trainer as such but rather a facilitator. As a general rule, unlike the professor or trainer the facilitator has less information than the participants, but he or she has mastered techniques for managing fruitful exchanges between the participants. The participants learn by exchanging information (some of which they may not have had at the beginning of their work together), and they compare various practices through case studies. A document server allows them to enrich their common knowledge base. Using these tools, they can solve problems in teams or carry out projects through which they will acquire new knowledge or skills.

This model is particularly well adapted to continuing vocational education; it has been used, for example, by teachers, physicians, and engineers to increase their knowledge and improve their practice. This model has also been used in university distance learning programs in which, for example, a course module is presented as a workshop organized around a task to achieve or a practice to reinforce.

Performance Support System

Just like the community of practice, the electronic performance support system (EPSS)[14] is centered on a professional task. However, in this case the training is mainly individual. It occurs in close connection with professional activities: during the activity when the learner needs training to progress in the task, after the activity when the learner wants to delve deeper into questions generated by the task, or even before the activity if the learner foresees the need for additional training before starting a task. An EPSS is closely integrated with the computer system used on the premises of the organization offering this support to its people, and in particular with institutional databases. A manager or a content expert, and sometimes on-line computerized advisers, maintain various training modules and provide task assistance. The user can thus obtain just-in-time information about the tasks to be achieved. Training in this model is seen as information processing. These features make the EPSS a dynamic training environment that is increasingly popular in collaborative learning at workplaces and in knowledge management activities.

Summary of the Models

The six e-learning models may be summed up as follows:

Three models are trainer centered: the high-tech classroom, the distributed classroom, and on-line training. The remaining three models are mainly learner centered.

Two models, the high-tech and the distributed classrooms, are synchronous, requiring the simultaneous presence of the learner and the

trainer in designated locations. The four other models are mainly asynchronous: the actors communicate between themselves or with the resources at the moment that is appropriate for them and from the location they select.

Two models, the hypermedia self-training and the performance support system, favor autonomous learning. The other models opt for communication and sometimes collaboration between learners.

Two models, the community of practice and the performance support system, are centered on the practice of a work task, or inspired by it. The other models tend to enable the processing of more general information.

Analysis of the Models

These models can be compared to each other in terms of the desirable characteristics suggested by the analysis of the new training contexts earlier in this chapter. Some of these characteristics pertain to flexibility, aiming to free learners (and trainers) from location and time constraints and also giving them more freedom in their use of instructional resources and their progression through the instructional activities. Other characteristics focus on the accessibility of local or global information, collaboration between learners, assistance from training agents, and the usability and ergonomics of the technological environment. Finally, some characteristics concern economics. They relate to the integration of work and training, the reusability of facilities, the maintenance or evolution of training environments, and finally, the relationship between training time and knowledge retention, to maximize training effectiveness.

Table 1-2 summarizes the characteristics associated with each model. A plus sign (+) indicates that a model is strong in a particular characteristic, and a minus sign (–) indicates a deficiency. These evaluations are more or less subjective; hence I invite you to perform your own evaluations after considering mine.

Table 1-2. Characteristics Analysis of Six Techno-Pedagogical Models.

	Model					
Characteristics	*1*	*2*	*3*	*4*	*5*	*6*
Frees users from location constraints	–	–	+	+	+	
Frees users from time constraints	–	–	+	+	+	+
Favors personalized learning	–	–	+		+	+
Access to local or global information	–	–	+	+	+	
Favors interactions between learners	–	–	–	+	+	
Offers training assistance	+	+	–	+	–	
Integrates user-friendly technologies	+	+				–
Favors work-training integration	–	–			+	+
Facilitates reengineering and reuse	+	+	–			–
Maximizes learning efficiency	–	–	+	+	+	+

Note: 1 = high-tech classroom, 2 = distributed classroom, 3 = hypermedia self-training, 4 = on-line training, 5 = community of practice, 6 = performance support system.

Processes and Development Tools

Figure 1-3 presents the main processes in an e-learning system, the actors involved, and the resources the actors use. *Resources* are any documents, software tools, and telecommunication or direct services used to input or process an activity managed by an actor. There are four main processes in the system's life cycle, going from a creation phase to a production phase to a delivery phase and finally to a maintenance and revision phase, where deficiencies revealed by the delivery of the learning system (LS) are detected and improvements are made to close up the loop and start a new cycle.

Together, these processes allow more interaction between the actors than traditional instruction does. The phases of creation, production, delivery, and maintenance and revision are enacted in a less sequential way. Although the

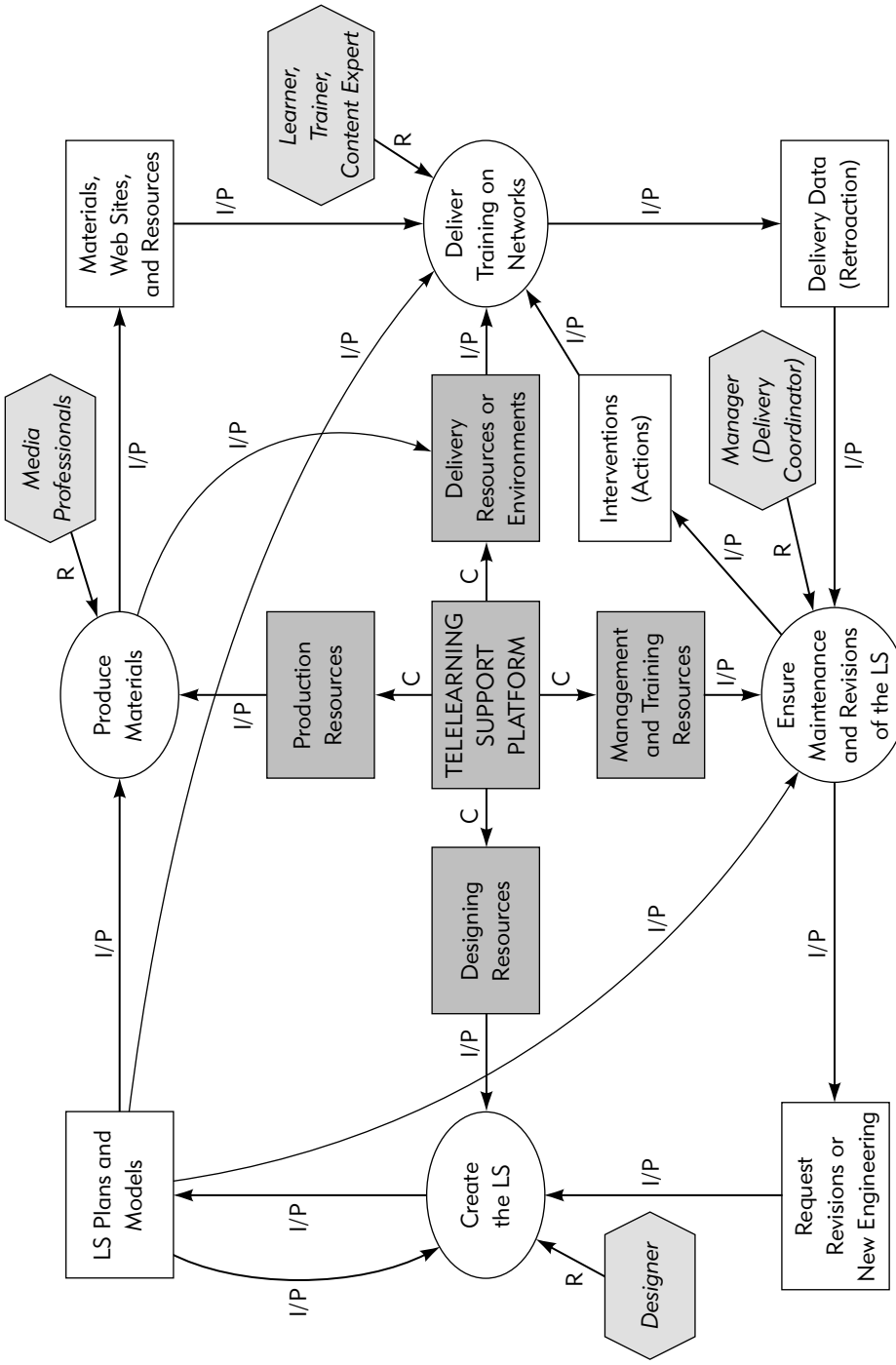


Figure 1-3. E-Learning Processes, Tools, and Actors.

Note: In diagrams such as this one, the tasks are framed by ovals, the resources or productions by rectangles, and the actors by hexagons. An R-link means that an actor "governs," or is responsible for, the task. A C-link means "is composed of," and an I/P-link means that the resource is an input or product of the task. (Links are discussed further in Chapter Three.)

processes can be discussed as occurring in a logical iteration, to understand their practical application it is best to think of them as operating more or less in parallel, with information continually shared between them. Let us look as these processes in more detail.

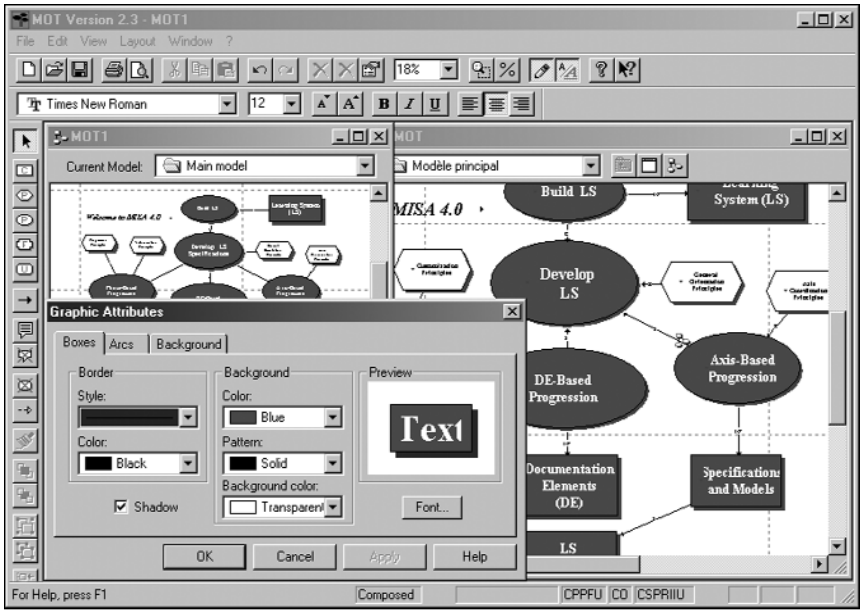
Designing the Learning System

The starting point for a learning system is a problem analysis performed by an educational organization: a university, college, corporate institute, department of human resources, or community educational group. Once an educational problem is defined, we can decide to start the production of a new learning system or to review an existing learning system. The first scenario is referred to as *instructional engineering* and the second as *reengineering*.

A learning system is a structured collection of materials, resources, environments, services, and human or technological infrastructures that support learning. Such a system can be described in terms of four models: a *knowledge model* describing the contents and the current and target competencies; an *instructional model* defining the course structure, learning activities, instruments, and other resources necessary to the learners and the human resources; *a media model* establishing the design of the Web site(s) or other resources and the design of each material used in the course, regardless of its format; and finally, a *delivery model* describing the roles of the actors at the time of delivery, the tools and channels of communication, the environment and services used, and the plan for the implementation, management, and maintenance of the learning system. As shown in Figure 1-3, the creation process produces inputs (models) for the three other processes and also for itself, for continuous reengineering.

There are two categories of e-learning system creation tools: specialized creation tools or job aids and integrated or nonintegrated design tools. Specialized creation tools (*job aids*) are used, for example, to analyze tasks and needs, to select the media, or to produce questionnaires or quizzes used to assess knowledge acquisition. There are also tools that permit the production of conceptual maps or knowledge models. The MOT software that produced the model shown in Figure 1-4 is one such tool (and it is discussed in some detail in Chapter Three).

Figure 1-4. Sample Screen for MOT: A Specialized Design Tool.



Designers may also use two other types of creation tools—integrated or nonintegrated—for courseware design. The use of nonintegrated tools makes it difficult to maintain the coherence of an e-learning system. Moreover, data transfer from one tool to another is a fastidious task that often causes errors and reduces the design team's productivity. Finally, such a solution does not allow the full operational use of instructional engineering principles and therefore does not adequately support the work of the design team.

Using integrated tools such as Designer's Edge or ADISA (discussed in Chapter Five) for courseware design ensures the coherence of the models. Such macro-design support tools, often called *front-end* tools, are used primarily to prepare work for another tool that will be used in the actual production of instructional materials for the learning system.

Producing Instructional Materials

Regardless of the courseware tools used, once the total design, or *macro-design,* is completed or sufficiently advanced, work can be started on the design of

individual materials, the *micro-design.* Then these materials can be produced, following the requirements of the media model produced at the macro-design stage. These materials will generally be integrated into (or linked to) a Web site that becomes the environment for the network of materials, activities, and services that constitute the "physical" e-learning system.

The type of development represented by these designing and production steps mobilizes important principles, methods, and tools and requires a solid methodology. It is easy to understand why many companies offer custom content authoring software targeted to e-learning content creators who have little time and few means. In 1997, I counted almost 400 multimedia courseware production tools available in the United States. Most of the tools offered have production functions for the Web, and new tools are being produced specifically for Internet delivery. Using these custom authoring tools, organizational content experts and trainers can produce their own computerized materials. However, multimedia development still requires the production of the basic media elements: graphics, sound and video sequences, and so forth. This need can be filled by contracting with media professionals or by using prefabricated content from media element banks. However, this latter option may generate some monotony and infringe on copyright laws.

Most important, a content expert who develops material with a custom tool does not generally master basic educational and media competencies, sometimes producing courseware whose quality is disappointing. Moreover, acquiring proficiency in these custom tools requires a rather long learning curve, with the risk that the expert or trainer may spend more time handling the tool than carrying out his or her primary role of designing instructional content and activities. Many educational organizations use custom authoring tools for the production of simple and time-limited training. An interesting solution to some of the problems presented by the use of these tools is to integrate small training products (less than one hour long) produced this way into a larger and more diversified training environment, which then offers learners more global and collaborative training activities. To create more elaborate productions, training organizations hire specialized firms while preserving their right to control the design and delivery of these materials on their internal networks or on the Internet.

Delivering Training on Networks

Once the materials have been validated and revised, the delivery model produced in the macro-design, or creation, phase is used to guide the way they are assembled with other resources and to build the actor's environment that will be implemented at delivery time. These resources are documents, tools, and e-services that users can employ to obtain information, produce assignments, collaborate with others, receive assistance in various situations, and finally, self-manage their own activities.

Many asynchronous delivery tools and services may be used in the actual transmission of the learning system to the user, such as forums, e-mail, file transfers, and bulletin boards. Synchronous delivery tools include chat rooms, audio or video streaming, bipoint or multipoint audio- or videoconferencing, whiteboards, screen sharing, and real-time e-presentations.

Maintaining and Reviewing the Learning System

As learning system delivery begins, maintenance and review activities also begin. If the system is, say, a specific university course, the responsible professor and his or her team will train the trainers, tutors, and supervising managers. The course groups are then created, trainers are assigned to groups, and the course starts. The evaluation results are sent to the registrar's office by the trainers or tutors, coordinated by the supervising managers. The managers organize the delivery of the learning events that are their responsibility and supervise the delivery by collecting data on-line from feedback questionnaires completed by the learners and trainers, from messages exchanged by learners and trainers in forums or by e-mail, or from learners' evaluations. The results of these analyses are transmitted back to the design team in the form of requests for changes that will improve the system.

Platforms and Portals

An e-learning platform is a software system that contains the tools and resources necessary to support the learning system actors—learners, trainers,

content experts, and managers—at delivery time.[15] A platform normally offers functions that allow

A *teacher-designer* to create standard courses grouping learning activities, instructional multimedia resources, and self-monitoring tools for students' activities

A *learner* to consult recommended instructional materials and resources on-line or to download those materials, to self-manage these materials and resources by observing his or her own learning evolution, to produce exercise or problem solutions, and to conduct self-assessment or to transmit productions or exams for evaluation by a teacher-trainer

Learners and facilitators (tutors, content experts, animators, managers, and so forth) to communicate, to suggest discussion topics, and to collaborate on common productions

A *platform administrator* to install the learning system and ensure its maintenance, to manage users' access rights, and to create links to external information systems

There are currently more than 300 distance delivery platforms available throughout the world, most of them obeying this definition. A number of comparative studies have analyzed these systems.[16] The majority of the platforms are based on a *Web hypermedia courseware* approach, integrated to various degrees with communication tools. Thus they favor certain techno-pedagogical models such as hypermedia self-training and asynchronous on-line teaching over others such as communities of practice and performance support systems. They also assume that each Web course is conceived independently from other courses and that the functions at the institutional level are in general limited to managing training operations.

The recent evolution from platforms toward *learning portals* is bringing a paradigm shift in this area, if not in practice at least in long-term objectives, because "portals carry a different training perspective rather than simply generalizing access to a predefined, preformed, even predigested content."[17] E-learning portals are organized as integrated Web environments where the

processes and services offered are more important than the platforms. These environments can be structured for one or many organizations, offering interfaces granting access to courses or instructional resources produced by various editors, on-line tutorial services, participation in professional communities, and links with performance support tools.

Perhaps increased use of learning portals can counteract the trend reflected in the finding reported by *Training* magazine that in all the training offered on the Internet in 1999, only 36 percent allowed interaction between people, a 14 percent decline from the interaction available in 1998.[18] These figures show that we still have a way to go before we make the best use of the true power of the Internet, which lies more in its capacity to create learning communities based on individuals' interactions than in its ability to provide more and more information.

Learning portals have great potential for increasing learners' access to formal and informal training, for facilitating communication and idea exchanges within the communities of practice, for integrating various functions while proposing an organic vision of learning, and for ensuring continuity between work and training while supporting competency and knowledge management in an organization. However, this enormous potential is far from being fully exploited today.

Even if they are increasingly evolving toward openness and diversity, the most popular platforms today are limited to a variety of weak of instructional strategies, providing in proprietary formats stereotyped steps or templates that facilitate the instructional task for trainers who are new to e-learning. Although some offer tools to import materials produced outside the platform, they remain relatively closed to the integration of external instructional materials. This means that course creators face problems when they wish to reuse learning system components and when they need interoperability of resources and instructional materials.

Several international groups are tackling the problems found with current platforms by developing technical specifications standards for instructional materials. The IMS Global Learning Consortium[19] is an international organization whose objective is to define the global architecture specifications for

on-line learning. Its members include such major manufacturers of authoring and training management tools as Allen Communications, Microsoft, PeopleSoft, Oracle, Saba, Sybase, IBM Education, Lotus, and Macromedia. Among the other organizations contributing to this standardization effort are the Aviation Industry CBT Committee[20] (AICC), the IEEE, ARIADNE, and the Advanced Distributed Learning Initiative. This last organization has produced the Sharable Courseware Object Reference Model (SCORM), a first definition of a reference model for computerized instructional objects that can be shared by a large variety of authoring tools and learning management systems.

Table 1-3 presents a summary of the five processes just discussed and their associated tools.

SUMMARY

In this chapter I have highlighted the main trends marking our progress toward becoming a knowledge society. Under the impact of the Internet and multimedia technologies, work and life in our societies are undergoing significant changes. Knowledge acquisition, and therefore learning and training, is now a prominent preoccupation of people, organizations, and governments.

In this vast societal movement, e-learning has become a major trend that we can no longer ignore. Most employees are now knowledge professionals. Thus it has become necessary not only to remove location and time constraints from information access but also to empower learners with the means to involve themselves, individually and in learning communities, in knowledge construction processes through which they will be able to develop the higher-level competencies they need to continuously adapt to the fast pace of knowledge evolution. Needless to say, this is an ambitious objective but one that we must achieve to ensure that wider distribution of technologies will lead to wider democratization of knowledge. Knowledge must be available through a variety of models, approaches, and tools so it can be adapted to users' diversified needs.

This chapter presented six techno-pedagogical training models. Two of them, the high-tech classroom and the distributed classroom, were very

Table 1-3. Synthesis of Instructional Engineering and Delivery Tools.

Tool Group	*Relevant Processes*	*Tool Examples*	*Comments*
1. Creation and instructional engineering	Design the models of LS: knowledge, instructional, media, delivery	ADISA/MOT Designer's Edge	There are few macro-design, or front-end, systems. Most of them cover only some of the tasks. The designers use various specialized tools such as graphic model makers or software packages. The ADISA workbench is a new support system for the main creation tasks of an e-learning environment.
2. Materials production	Produce materials and media elements	Authorware Director Dreamweaver FrameMaker PhotoShop Toolbook	The custom authoring tools allow the fast development of multimedia products. If the production is somewhat complex, the instructional system software developers will use a variety of media production and programming tools.
3. Delivery tools and services	Deliver the information; support communication	Outlook NetMeeting MediaPlayer Multimedia One	Various commercial tools offer synchronous or asynchronous communication services. Other tools and services created for instructional purposes are used for collaboration, follow-ups, and remote tutoring.
4. Training management systems	Manage the events and the students' files; maintain and revise the LS	PeopleSoft SAP SIGAL TopClass Training Office	SIGAL is an example of a competency management system for an organization. The general management systems such as SAP offer a training module. Management tools are also offered in integrated systems, or integrators. No system covers all of the required functions, particularly regarding the management of training quality.
5. Platforms or integrative systems	Produce materials; deliver training on the Internet; manage training	Explor@ Learning Space Librarian Virtual U Web CT	These systems aim to integrate delivery tools or services with materials. Certain systems integrate the materials in a proprietary format. Other systems facilitate the integration of the materials and resources produced outside the tool.

popular at the end of the 1990s. They have the advantage of feeling familiar to educators and trainers accustomed to traditional classroom settings, but they require expensive videoconferencing equipment and the simultaneous presence of learners and instructors. Although extremely useful in certain contexts, these models are probably not fulfilling the needs of the present and will fall further behind in the future, when mobile, busy people will need to develop and use high-level intellectual skills in a socioeconomic context that requires continuous and lifelong learning. New techno-pedagogical models such as hypermedia self-training, on-line training, communities of practice, and performance support systems are better adapted to fulfilling the needs of the knowledge society.

Taking into account the colossal energies currently devoted to this field, significant technical progress is expected in the areas of general Internet standards and specific standards for network-based learning, platform interoperability, and new generation authoring and delivery systems. However, the most important evolution must take place elsewhere. The following chapters go beyond technological innovation questions and address the more profound pedagogical issues that must come to shape our instructional engineering methods and principles.