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An instructional model for web-based e-learning education with a blended learning process approach

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Abstract

Web-based e-learning education research and development now focuses on the inclusion of new technological features and the exploration of software standards. However, far less effort is going into finding solutions to psychopedagogical problems in this new educational category. This paper proposes a psychopedagogical instructional model based on content structure, the latest research into information processing psychology and social contructivism, and defines a blended approach to the learning process. Technologically speaking, the instructional model is supported by learning objects, a concept inherited from the object-oriented paradigm.

Introduction

Computer-assisted teaching using the Internet has radically changed the teaching paradigm. The conventional education system has focused on transmitting the teacher's knowledge (what the teacher knows, which is not necessarily what he or she should know) to students. However, it has paid less attention to the other aspect of education, namely, *learning*. Learning is the acquisition of new mental schemata, knowledge, abilities, skills, etc, which can be used to solve problems potentially more successfully, furthering decision making on the basis of experience, which elevates "doing" as a basis for achieving an effective understanding of the knowledge (Pazos, Azpiazu, Silva & Rodriguez-Paton, 2002).

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The learning process is optimum when it is assisted and personalised (Gell-Mann, 1996). In the olden days, the wealthy engaged tutors for their children, who thus received efficient personalised education. Computers are the potential saviours of the education system, because they can be used to personalise learning. They can design our learning according to our knowledge and needs, record the progress we make, and tell us if any thought process is wrong so it can be corrected.

With the development of the Internet, Internet-based computerised learning, known as *e-learning*, has attracted the attention of educators. E-learning is defined as "the use of new multimedia technologies and the Internet to improve the quality of learning by facilitating access to resources and services, as well as remote exchange and collaboration" (EC, 2001) or "the use of network technologies to create, foster, deliver, and facilitate learning, anytime and anywhere." [URL: Line Zine].

Essentially, e-learning is an alternative way to teach and learn. It is a recent phenomenon that has not yet incorporated the pedagogical principles of teaching (Bixler and Spotts, 2000). Recent research on e-learning tools for learning via the Internet has found that the software design of these tools does not stretch to pedagogy, and the pedagogical manner in which these tools are used in teaching is left to the educators (Govindasamy, 2002).

There is a serious dysfunction between the profusion of technological features that are put forward and the shortage or non-existence of teaching principles for e-learning. There are no guidelines for analysing, designing, developing, supplying, and managing e-learning materials pedagogically. Evidently, e-learning cannot continue without pedagogical techniques, and these should, if possible, be aimed at personalised teaching, which, as mentioned above, is the best.

Pedagogical principles are theories that govern good educational practice, and, as far as e-learning is concerned, good educational or instructional practice is represented by the instructional technology. Instructional design has evolved in combination mainly with the development of the three basic learning theories: behaviourism, cognitivism, and contructivism.

The theory of behaviourism concentrates on the study of overt behaviours that can be observed and measured. It views the mind as a "black box" in the sense that response to stimulus can be observed quantitatively, totally ignoring the possibility of thought processes occurring in the mind (Good & Brophy, 1990). Saettler (1990) identified the impact of behaviourism on educational technology with areas such as the programmed instruction movement, computer-assisted learning, etc. The behaviourist approach had limitations as regards the understanding of learning. For example, behaviourism was unable to explain some social behaviours. People could imitate behaviour that they had not reinforced. An individual could model behaviour by observing the behaviour of another person (Bandura, 1977).

In response, the cognitive theory emerged. Although it accepts behaviouristic concepts, cognitivism views learning as involving the acquisition or reorganisation of the cognitive structures through which humans process and store information. The mental processes transform the information received through the eyes and ears into knowledge and skills within the human memory. Learning takes place, thanks to a process activated within the working memory (short-term memory), for which purpose it uses knowledge and skills retrieved from the long-term memory. The new knowledge and skills are then stored in this memory. The influence of cognitive science on instructional design is evidenced by the use of advanced organisers, metaphors, chunking into meaningful parts, and the careful organisation of instructional materials from simple to complex.

Constructivism builds upon behaviourism and cognitivism in the sense that it accepts multiple perspectives and maintains that learning is a personal interpretation of the world. Constructivist theory sustains that learners construct or at least interpret their own reality based upon their perception of experiences. Therefore, an individual's knowledge is a function of his or her prior experiences, mental structures, and beliefs that are used to interpret objects and events (Jonassen, 1991). One of the most useful tools for the constructivist designer is hypertext and hypermedia because it allows for a branched design rather than a linear format of instruction.

Social constructivist theory bore Anchored Instruction (Bransford, Sherwood, Hasselbring, Kinzer & Williams, 1990). Its instructional design is based on a general model of problem solving around an "anchor," which may be a theme, case study, or problem to be solved. Learners engage in exploration and discovery learning. Anchored Instruction is actually a paradigm for technology-based instruction.

As an online learning vehicle, Palloff and Pratt (1999) suggest the learning community, where a group of individuals who are interested in a common topic or area are engaged in knowledge-related transactions, as well as transformation within it. They state that an online community has been formed when there has been: active interaction involving both course content and personal communication, collaborative learning evidenced by comments directed primarily student to student, socially constructed meaning evidenced by agreement or questioning with the intent to achieve agreement on issues of meaning, sharing of resources among students, and expressions of support and encouragement exchanged between students, as well as willingness to critically evaluate the work of others.

The instructional model we propose is supported by a blended and eclectic view of these learning theories. What you think is knowledge determines your approach. Basically you can view knowledge as: something to be acquired from outside, a cognitive state of the person that is the result of a thought process, or a meaning constructed by social interaction. Then your focus will be on: content structure, cognitive processes, and collaborative activities. We believe that these perspectives are interdependent and their recommendations can be mixed to build instructional design heuristics. We have designed our e-lesson following psychopedagogical prescriptions inspired by these different approaches.

First, we look at the content structure. "Organizing information into a conceptual framework allows for greater transfer" (Donovan, Bransford & Pellegrino, 1999). We structure content according to information types and performance goals (Merrill, 1983). The aim is to develop coherent information structures that help to build knowledge schemas in the learner's mind. Knowledge schemas are key to the effective understanding of and thinking in a specific field.

Second, we focus on the cognitive process of understanding how the mind works during the learning process and what factors determine and condition the success of the process. The proposed psychopedagogical instructional model aims to guide the transformation of the information received by the learner in the sensory memory into structured knowledge that is stored in the long-term memory.

Third, human learning is constructed not only by interacting with the content but also by working together with colleagues and instructors. Palloff and Pratt (1999) stated that "in the online classroom, it is the relationships and interactions among people through which knowledge is primarily generated"; "attention needs to be paid to developing a sense of community in the group of participants in order for the learning process to be successful." In the design and development phases, therefore, we include activities designed to create a social environment that act as a scaffold for collaborative learning. During the execution phase, the instructor nurtures and promotes a sense of learning community between participants.

This paper, then, outlines an instructional e-learning model, based on the e-lesson, whose goal is to achieve assisted and personalised teaching, adopting a blended approach to the learning process. The e-lesson is defined as the minimum *self-contained* learning unit.

The model includes prescriptions and methods borrowed from different fields of knowledge. For the design and implementation of the educational contents, we have used principles based on the content performance matrix (Merrill, 1997), multimedia principles derived from the latest research on information processing psychology within the field of cognitive psychology (Clark, 1999, 2003). Also a collaborative environment is developed in the execution phase by designing both synchronous and asynchronous group activities. The instructor role is key to encouraging and guiding students in this process.

Accordingly, the targeted learning objectives are linked with the underlying contents, knowledge, and skills, employing a structure that depends on their class: facts, concepts, processes, procedures, and principles.

The remainder of the paper is structured as follows. Section 2 describes the learning stages and educational objectives that a learner can achieve through learning. Section

3 presents the psychopedagogical instructional model that we have structured according to design prescriptions taken from the fields of both instruction and learning and, particularly, from the latest advances in cognitive psychology. Section 4 describes a blended implementation for the learning process and Section 5 presents the conclusions.

Learning stages and educational objectives

Learning is not a single activity; it includes at least three different stages: accretion, restructuring, and tuning (Rumelhart & Norman, 1978). *Accretion* is the insertion of knowledge into established structures. *Restructuring* is the formation of new conceptual structures suited to the knowledge, and *tuning* involves making this knowledge efficient, that is, progressing from the unsure and anxious state of the learner to the serene and experienced skill of the expert.

It is not enough to understand and learn a subject. When a subject has been learned, it should be used. It should be practised. It should be tuned until it is used effortlessly. An old proverb says, "I heard it and I forgot it, I saw it and I remembered it, I did it and I learned it." For example, the fact that you understand the square root principle does not necessarily mean that you will be able to calculate a square root with ease. If the principle is understood but not automated, any attempt to apply it will end up in frustration. Learning does not stop at comprehension; the underlying fundaments need to be completely automated. It has been calculated that it takes approximately five thousand hours (over two years working eight hours a day) to become an expert in a subject, for example, to become a specialist in medical imaging.

As the ability to think is severely constrained by the size of the *short-term memory*, the basic fundaments of any subject should come to mind automatically, without having to expend valuable mental resources. And, as far as we know, automaticity only comes with repeated practice.

Additionally, a lot of things happen in a student's mind. Students interpret and overinterpret. They work very actively to attach a meaning to and structure the new knowledge with which they are presented. They learn according to the *iceberg* model: the visible part of the iceberg reflects the real knowledge that the student has about a subject, under which an immense conceptual substructure has been erected to explain this visible part of the assimilated knowledge. Therefore, the best teaching policy is to provide the subject-related conceptual models and substructures, because, otherwise, the students themselves will develop their own, which are likely to be less appropriate than those suggested by the teacher.

During learning, learners acquire levels of knowledge, which Bloom defined within a taxonomy of educational objectives (knowledge, comprehension, application, analysis, synthesis, and evaluation), which is still widely accepted today (Bloom, 1956). These objectives describe several knowledge levels, intellectual capabilities, and skills that a learner can achieve through learning and which, briefly, are:

1. Syntactic level—where the learner acquires the **knowledge and understands** its fundaments and the underlying reasoning processes.
2. Semantic level—learners are able to successfully tackle **analysis and synthesis** processes in new or complex situations. They have the ability to decide what method, knowledge, and instruments to use in each case. This knowledge is demonstrated by describing knowledge maps, decision tables, etc, of real problems.
3. Pragmatic level—learners are able to **apply** the knowledge acquired to solve particular problems and to **evaluate** the methods, processes, and tools to be used, which they can judge both qualitatively and quantitatively.

Schulman (2002) identifies a six-stage learning process: engagement and motivation, knowledge and understanding, performance and action, reflection and critique, judgement and design, and commitment and identity. Learning begins with student engagement, which in turn leads to knowledge and understanding. Once a learner understands, he or she becomes capable of performance or action. Critical reflection on one's practice and understanding leads to higher-order thinking in the form of a capacity to exercise judgement in the face of uncertainty and to create designs in the presence of constraints and unpredictability. Finally, the exercise of judgement allows the learner to develop commitment. In commitment, he or she becomes capable of professing his or her understandings and his or her values, internalising those attributes and making them integral to his or her identities. These commitments, in turn, make new engagements possible and even necessary.

Instructional model

The e-learning instructional model is based on the fact that the training should enable learners to **apply** the concepts learned at their workplace and **evaluate** the results. That is, it should provide the pragmatic level and the practical tools for the learners to be able to put into practice what they have learned.

The aim is for learners to be engaged by the e-learning contents to the extent that they get to understand things that they did not comprehend before. This will make them ready to practice and take action to perform new activities. But by acting, they will realise that their actions do not always produce the right results, leading them to re-examine their actions to see whether they need to act differently or not. By means of this reflection on their performance and understanding, learners will come to be able to make judgements and devise designs. Thus, learners will start to internalise the knowledge that they have learned. By this stage, learners are no longer just engaged, they are well and truly committed. These commitments, in turn, lead them to seek out new engagements with new contents, which point them in the direction of new understanding and practices.

This instructional model is based on the systematic development of instruction and learning and is composed of seven phases (Figure 1): analysis, design, development, implementation, execution, evaluation, and review. The model includes a series of psychopedagogical prescriptions that further the learning process.

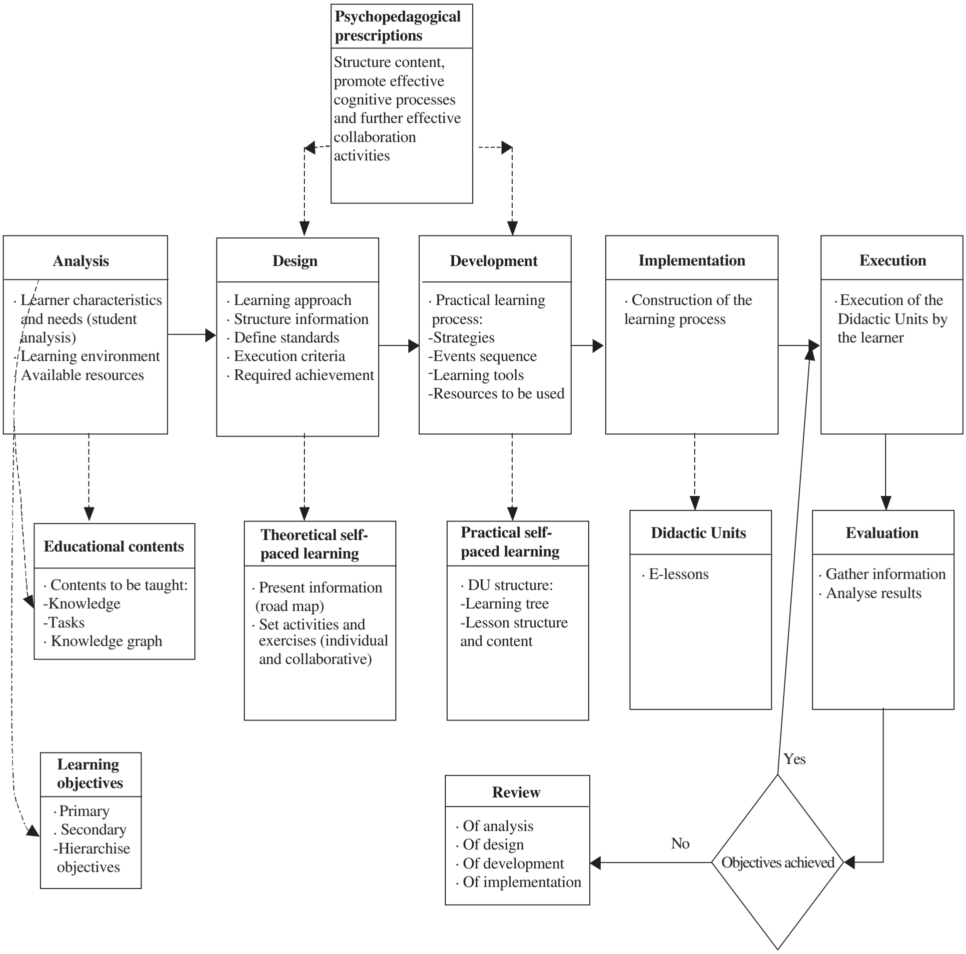

Figure 1: E-learning instructional model

1. Analysis: this phase defines **what** to teach. The learner and the educational contents to be taught are analysed. Its purpose is to detect the learner's learning characteristics and needs, and ascertain the environment in which the learning is to take place and the available resources. It outputs two documents:
   - Learning objectives, which define the primary and secondary objectives, as well as their hierarchical structure.
   - Educational contents, which defines the knowledge and skills to be learned and the tasks to be developed to acquire this knowledge.

     Knowledge is the set of facts, concepts, and processes that the learner has to use properly to solve future problems related to the subject to be studied. The tasks are the set of procedures and principles that can be used to solve given subproblems within the domain in question.

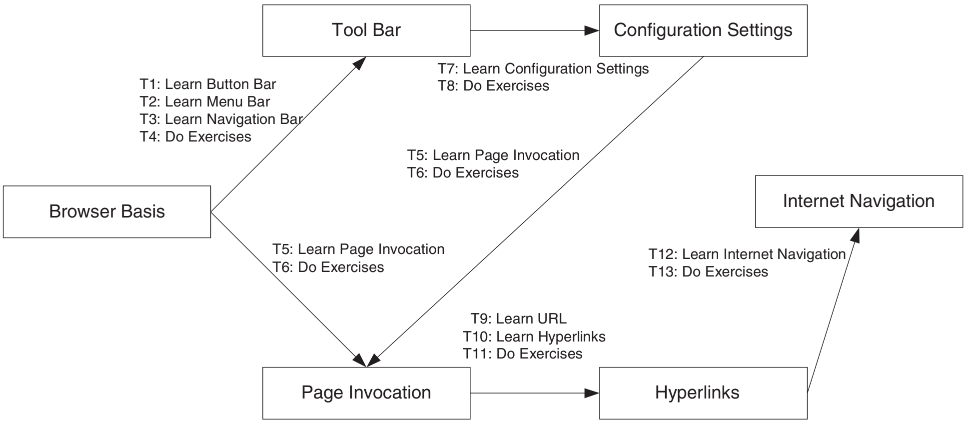

Figure 2: Knowledge graph for learning Internet navigation

The educational contents are represented by means of a *knowledge graph*. A knowledge graph is a simply connected, directed acyclical graph composed of a set of nodes that represent the knowledge to be acquired, connected by means of arrows that indicate the tasks to be performed to reach the goal knowledge state. By way of an example, Figure 2 shows the knowledge graph for the "Internet Navigation" learning domain. This knowledge graph contains six nodes, which represent acquired knowledge states. The arcs are tasks to be performed to reach each state. In this example, it is assumed that the learner has basic knowledge of browser operation, which is represented by means of the *Browser Basis* knowledge state, from which the other states can be reached. The *Internet Navigation* node is the goal state to be reached after performing the proposed tasks, represented by T1, T2,… , T13.

2. Design: this phase defines **how** to teach. It specifies the learner's learning process, defining the learning approach, the structure and granularity of the information to be delivered (facts, concepts, processes, procedures, and principles), standards to be used, execution criteria, and achievement expected of the learner.
   The presentation of information depends on the type of contents to be taught and should differ depending on whether the aim is to teach facts, concepts, procedures, or principles. The method includes setting activities and exercises to evaluate the knowledge acquired.
   The design phase outputs the *Theoretical Self-Paced Learning Process*, which describes the process of learning the educational contents by means of a structured presentation of the information, using an information diagram or road map.
   The road map is the set of Hamiltonian paths that go from the start state to the goal state of a connected, directed acyclical graph, whose nodes represent the *learning objects*.
   Figure 3 shows the road map for the "Internet Navigation" learning example described above. The arrows indicate the possible alternative educational processes

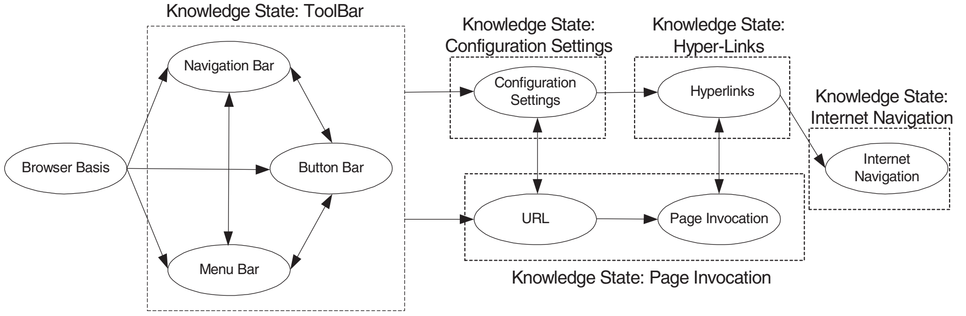

Figure 3: Road map of the "Internet navigation" learning process

that can be implemented to reach the *Internet Navigation* knowledge state. For example, *Navigation Bar*, *Button Bar*, or *Menu Bar* can all be accessed from *Browser Basis*. The arrows start from either a road map node (a learning object) or a rectangle that groups several nodes (a knowledge state). In the second case, the arrows indicate that all the nodes grouped in the rectangle have to have been correctly completed before accessing the next node. This applies, for example, for accessing *URL* or *Configuration Settings*, where *Navigation Bar*, *Menu Bar*, and *Button Bar* all have to have been completed.

3. Development: this phase describes the real learning process, including the tools that are to be used to teach. The materials, strategies, event sequences, and necessary resources are prepared. This phase outputs the *Practical Self-Paced Learning Process* applicable to the real structure of each teaching unit, which includes a *learning tree* containing the structure and contents of each e-lesson. The learning tree is built by selecting the best of all the possible Hamiltonian paths for reaching the target knowledge state set out in the road map.
   The learning tree for "Internet Navigation" is shown on the right-hand side of Figure 4. On the left-hand side is the route selected within the road map for building the tree. Note how each node (learning object) reflected in the road map matches a section of an e-lesson. Accordingly, a series of exercises or activities, defined as tasks in the knowledge graph, have to be carried out to reach a new knowledge state.
   It should be noted that the example shown in Figure 4 is composed of two e-lessons: the Browser and Navigation Basis.
4. Implementation: this phase involves building the software of the e-learning process using an authoring tool, and its location in a learning management system (LMS) platform.
   It outputs the different didactic units, with their respective e-lessons, of which this learning is composed. Figure 5 shows the implementation of the didactic unit "Internet Navigation" in the learning authoring tool.
5. Execution: this phase involves the learner using the learning process. This execution provides information on the problems encountered and the knowledge acquired.
6. Evaluation: information output during execution, which is stored in the learner log within the LMS platform, is gathered, and the results are analysed on the basis of

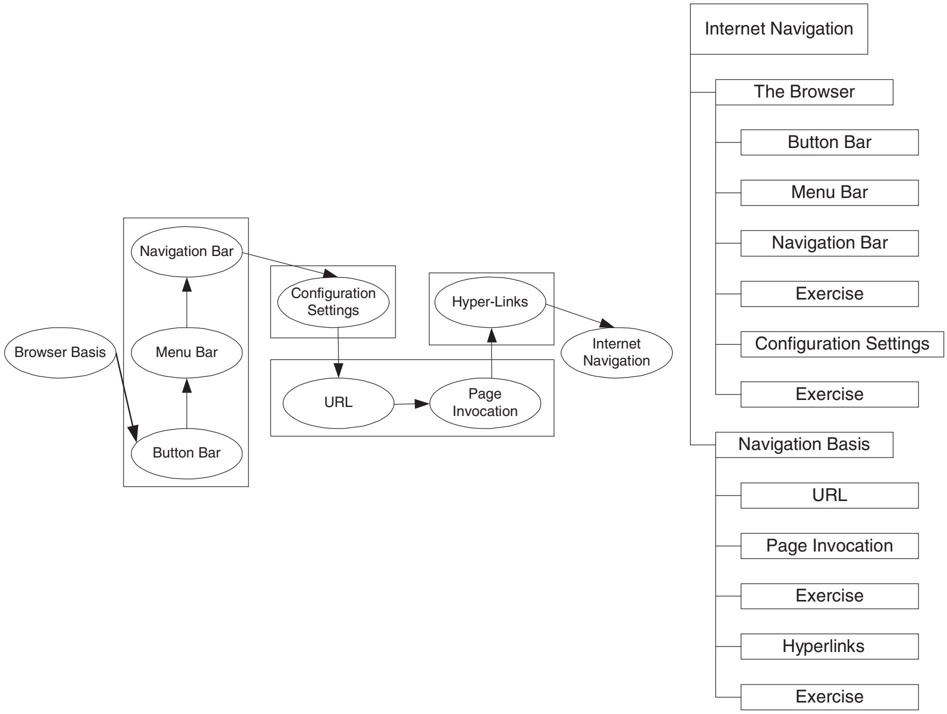

Figure 4: Selected route and learning tree for "Internet navigation"

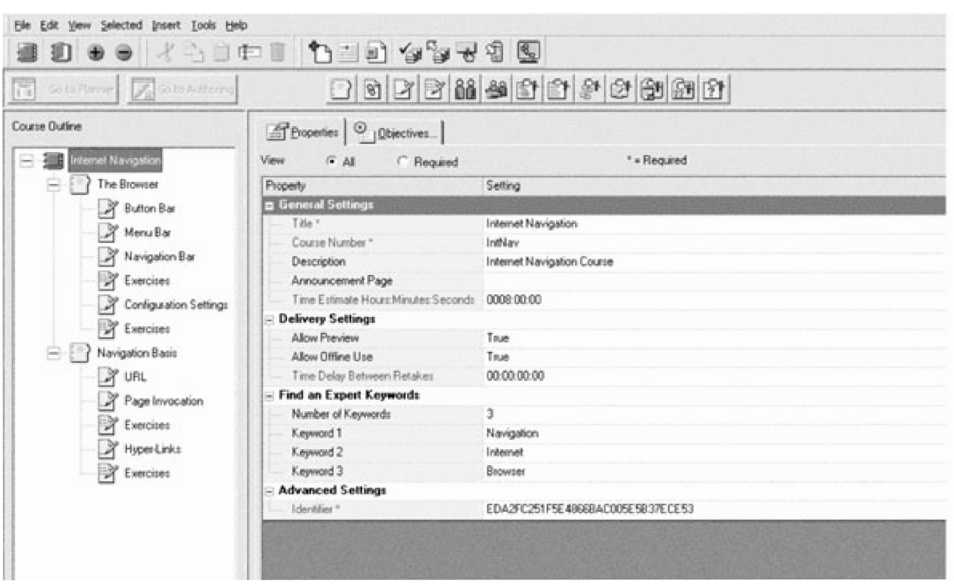

Figure 5: Implementation of the didactic unit "Internet Navigation" with the learning authoring tool

Section	**Start date**	**Number of connections**	**Time elapsed**	**Grade out of 10**	**Status**
Button Bar	15/07/03	5	0h. 53 min.	8	Finished
Menu Bar	20/07/03	4	0h. 42 min.	**4**	**Not passed**
Navigation Bar	23/07/03	3	0h. 38 min.	**3**	**Not passed**
Configuration Settings	27/07/03	4	0h. 45 min.	7	Finished
URL	31/07/03	2	0h. 25 min.		Learning
Page Invocation					Not started
Hyperlinks					Not started
TOTAL:		18	3h. 23 min.	Mean: 5.5	

Figure 6: Learner log

the learning objectives. The log can be used for monitoring purposes to determine successes and ascertain the learning product quality. Figure 6 shows a log of a learner who started the course on 15 July, connected a total of 18 times, studied for a total of 3 hours 23 minutes, completed four tasks (*Button Bar*, *Menu Bar*, *Navigation Bar*, and *Configuration Settings*), attained an average grade so far of 5.5, and is now working on the fifth task (URL).

The learner received a good grade for Button Bar learning. Then, he got two poor grades and, again, another good grade. This can occur when the route selected in the road map for reaching the target knowledge state is not optimum. The self-adapting learning system detects such situations and dynamically modifies the course contents tree in the course of the didactic unit. This gives learners a different view of the contents to be learned to assure that they get good grades in all the sections of which the course is composed.

7. Review: this serves to refine the learning process by analysing the results of the evaluation. Any instructional model phases can undergo review.

Psychopedagogical prescriptions

Content structure

We follow the overarching idea in Ausubel's theory that knowledge is organised and, therefore, expository teaching should be structured to connect new information with the learner's existing cognitive structure. More specifically, we design and develop training using Clark's methodology (Clark, 1999) based on Merrill's Component Display Theory (Merrill, 1983).

The design differentiates five basic content types—facts, concepts, processes, procedures, and principles—and two performance outcomes—remember and apply. These two dimensions conform the content performance matrix that prescribes a template for optimising learning for each content type: outcome combination.

Cognitive process

Prescriptions derived from well-founded cognitive principles taken from numerous pieces of research (Clark, 2002) are taken into account in each and every one of these

Table 1: Prescriptions that promote and improve learning

Processes	*Sensory memory*	*Working memory*	*Long-term memory*	*Examples of actions*
Perception	Automation		Patterns	Visual formats, texts, fonts, colours, etc
Attention	Signs and pointers	Learning objective personalisation		Language, vocabulary Questions Boxes
Cognitive load		Contiguity Modality Redundancy Coherence Automation Solved examples		Text incrusted in pictures Pictures + audio Avoid redundant information Distribute information between text, pictures, and audio Remove ornamental materials
Coding		Multimedia Background knowledge	Relate Differentiate Elaborate	Presentation as text and pictures Knowledge organisers (indices, objectives, preliminary questions,...) Conceptual maps Process diagrams Simulations
Retrieval/ transfer			Context Practice PBL	Example specificity Encourage distributed and extensive practice
Metacognition			Thinking and discussion strategies	Checklists Questions and sentences aimed at the thought process Forums and dialogues with tutors and fellow students

phases, and especially during *design* and *development*. These actions apply to different structures and processes of the information processing model. Table 1 shows the actions taken during the design and development of the didactic contents that further the cognitive processes supported by the memory structures and involved in learning.

- Perception: If a visual structure (format, fonts, colours, etc) is provided and maintained throughout the courses, students will be able to differentiate and identify the content type and the perception processes will be automated. Once assimilated by the long-term memory, the patterns further the automatic allocation of meaning to the visual stimuli, as they are constant throughout the presentation of the contents.

- Attention: Because students receive a huge amount of information and people have limited information processing capacities, it is critical to select the parts to which they should pay attention. When designing instructional contents, methods that optimise the attention process by easing the selection of important material should be included. The use of highlighting and pointers, such as headings and boxed texts, facilitates the more unconscious task of the sensory memory. Formulating the right questions, using simple grammar and vocabulary (active voice, short sentences, no substantivisation, etc), clearly establishing learning objectives, and addressing students personally and informally improve their conscious attention and, consequently, the effectiveness of the working memory.
- Cognitive load: The capacity of the working memory limits how much work students can do effectively. Their cognitive effort therefore needs to be effectively managed during contents design. Methods should be used that reduce the foreign cognitive load not related to the content type. For example, incrusting text in pictures (principle of contiguity) reduces the effort required to retain the information presented in the text and then locate it in the picture. Distributing the information across auditory and visual media (principle of modality) reduces the effort of each processing channel. Redundant presentation should also be avoided, and care should be taken to assure that the information is coherent and to remove anything that is irrelevant and ornamental. Automating procedural tasks by means of practice, using solved examples, releases resources and likewise lightens the cognitive load.
- Coding: This is the process by means of which learning is incorporated into the long-term memory. The key lies in the processing activities that integrate the information to be learned with the information available in the long-term memory. Information presented as text and illustrations can be recalled better than information that is presented as text only. The use of knowledge organisers activates any previously available schemas related to the material to be learned and improves its integration. A deep, as opposed to superficial, processing level (Craik & Lockhart, 1972) focused on the meaning is coded in the semantic memory and remembered better. Therefore, activities that relate the new information to, or differentiate it from, previous knowledge improve learning. Conceptual maps and process diagrams organise the information and improve the construction of mental models. Simulations permit experimentation and the correction or validation of established assumptions.
- Retrieval/transfer: Coding and retrieval are related and considerably influenced by the context. To improve learning, contexts with which students are familiar should be provided. As coding specificity determines the retrieval process, the examples should be as close as possibleto the context to which the learning is to be transferred. When the aim is wider generalisation, a wide variety of examples in different contexts and distributed and extensive practice should be provided.
  Problem Based Learning includes specific tasks of the learning domain and pursues real job objectives. This design focuses on developing the skills and knowledge needed to solve the problem.
- Metacognition: Finally, improving the control of all these processes by developing metacognitive strategies in students improves and furthers learning effectiveness.

Metacognition refers to the knowledge that students have of their own thought processes. It is important to further this knowledge by means of strategies of reflection. Checklists can be used, such as: What is the objective? Do I know anything about the subject? Do I understand as I go along? Do I have difficulty with any concepts? Do I know how to correct my mistakes? and others. Forums and dialogues with tutors and fellow students also help students to check their knowledge and correct mistakes.

Collaborative activities

When we use collaboration to enable people to learn together, we make learners more active and self-reliant. Also "the active, collaborative, reflective re-examination of ideas in a social context is one of the most important remedies for combating the illusion of misunderstanding and persistence of misconceptions" (Schulman, 1999). Collaboration needs to be structured and built. We base this structure on three components:

- Activities
  These are the guidelines for designing activities:
  - Relate collaborative activities to the learning objectives.
  - Prepare assignments that require collaboration.
  - Size groups and backgrounds of participants to optimise interactions.
  - Structure group assignments around products (ie, a project) or processes (ie, a problem-based learning)
- Participants
  In *The Virtual Student*, Palloff and Pratt (2003) discuss best characteristics of students in an online course: openness, flexibility and humour, honesty, and willingness to work collaboratively. The spirit of collaboration is fundamental to a successful learning community. But our participants need to at least be committed:
  - to be respectful of other participants;
  - to do a fair share of work; and
  - to help each other and provide feedback when testing ideas or knowledge.

  A picture and brief biographies of the instructor and learners should be posted.
- Instructor
  To be efficient in developing collaborative learning, the instructor should in the implementation phase:
  - Make everyone feel welcome.
  - Express himself or herself with clarity to avoid misunderstanding.
  - Teach how to build collaboration.
  - Invite students to participate.
  - Give feedback as soon as possible.
  - Moderate actively but not dominate.
  - Be a model to imitate.
  - Set limits when participation is in the wrong direction.

E-lesson

The instructional method defines the e-lesson as the minimum *self-contained* learning unit. An e-lesson is composed of a set of facts, concepts, processes, procedures, and principles that can be learned on the basis of the current knowledge of the learner. The e-lesson is divided into six sections:

- Presentation: describes the subject that will be developed throughout the sections of which the e-lesson is composed. It is responsible for motivating and providing guidance to learners about the knowledge they are to acquire.
- Objectives: indicates what the result of the learning will be, briefly describing the tasks that learners will be able to perform.
- Necessary knowledge: provides the information and instructions associated with the steps required to perform the task to be learned in the e-lesson.
- Learning tasks: teaches the skills and tasks to be learned.
- Practice: consolidates what was taught in the last two sections by putting it into practice on a real case. Discussions and group activities drive community learning.
- Conclusion: reinforces and recalls the key points learned throughout the e-lesson. Its objective is to focus the learners' attention and get them to think about whether or not they have achieved the proposed objectives with regard to certain key issues.

These six sections of which an e-lesson is composed within the instructional model are divided into two categories: content sections and context sections. The content sections are composed of the necessary knowledge and the tasks to be learned, which make up the body of the e-lesson. The presentation, objectives, practice, and conclusion are context sections, which serve to provide the learner with guidance about the content of the e-lesson.

This e-lesson structure provides a consistent framework that covers the needs of the instructional method for learning.

Implementation of a blended approach to the learning process

The instructional learning model provides instructors with the capability of generating personalised e-learning processes focused on some educational objectives and on the characteristics and needs of learners.

Orthogonally to this instructional view is the learner's perspective, in the sense of how the learning should take place for learners to optimally acquire the knowledge. A series of specialists in the subject advocate a blended learning solution (Cross, 2003; Davies, 2003; Hulm, 2003; Thorne, 2003). Blended learning is used to describe learning that mixes various event-based activities: self-paced learning, live e-learning, and face-to-face classrooms.

Self-paced learning is what the learner does by executing the e-learning process. Self-paced activities can be taken at the learner's leisure, that is, can be taken anytime and anywhere. The important thing these days is not only to access knowledge but also to access relevant and interesting knowledge in time. The value of self-paced learning is not only that it can reach everyone at any time and anywhere, but that it can teach the learner appropriately, providing the right skills at the right time.

Live e-learning takes place in a virtual classroom at a scheduled time at which learner undertakes to attend, just as they would a traditional class, minus the travel. Learners can collaborate, share information, and ask questions of one another and of the instructor in real time. Live e-learning is good for sharing information. This type of training works best if the class size is limited to 25 people to allow for optimal group interaction.

Traditional classroom training will always be, despite its defects, an effective means of learning. Classroom training is still unbeatable for the amount of face-to-face interaction with both the instructor and classmates that is necessary to learn certain management, leadership, and other highly collaborative skills (Michell 2001).

The self-paced learning and live e-learning facets of blended learning have the following properties:

- Dynamic: have experts online, the best sources and fast access to information for quick reaction.
- At real time: you get what you need, when you need it.
- Collaborative: because people learn from one another. Blended learning connects students with colleagues or experts both in and outside the organisation.
- Personalised: each student selects his or her activities from a personal menu of learning opportunities most relevant to his or her background, job, or carrier.
- Comprehensive: provides learning events from many sources enabling the learner to select a favoured format or learning method or training provider.
- Enabling the organisation: e-learning forms learning communities whose members forge ahead.

An efficient blended learning solution includes a mixture of the three learning types with the following ingredients:

1. An instructor that directs learning.
2. Email and telephone assistance for personalised learner support.
3. Virtual classes by means of computerised videoconference, in which the instructor explains specific learning subjects to the group and learners raise questions.
4. Interaction between learners and the instructor and between the learners themselves through the chat to stimulate group learning.
5. Support and query line for subjects related to learning management (enrolment LMS platform problems, etc)
6. Assessment examinations.
7. Certificate and diploma that certifies having taken or passed the course.

These learning instruments are combined differently depending whether the personalised teaching targets a group or an individual. In personalised group teaching, the instructor creates a *self-paced learning process* for each learner taking into account the core objectives of the course and structures its development applying the learning instruments described above. If the group does not have computerised videoconference support, activity 3 is dropped and activities 2 and 4 are reinforced. In individual personalised learning, the instructor creates a *self-paced learning* process for the learner, and the learner executes the process following the instructor's instructions. The interaction takes place through activities 2 and 4. Activity 7 depends on whether or not a certificate or diploma needs to be issued. So, we think this blended learning embodies the interrelated characteristics advocated by Donovan *et al* in their book *How People Learn: Bridging Reseach an Practice* (1999):

- Maintenance of a learning-centred environment
- Provision of a knowledge-centred environment
- Formative assessment that makes student thinking visible to instructors and colleagues
- Building of a interactive learning community

Blended learning combines training, coaching, and self help. It involves more management, accepting that people development is a continual process, through which experience doing the work is gained (Davies, 2003). The future direction of learning has been defined as "blended learning" according to many company executives and e-learning system providers. They have found that their customers are blending multiple training practices to provide a fuller, more beneficial training experience for their employees.

We have been training Spanish central and local administration computing specialists for over 10 years through the Master in Information and Communications Technologies Management [URL: INAP], where first we applied classroom learning, which was later combined with live e-learning, to which self-paced learning has been added over the last two years. From this experience we can say that a blended learning process that is well-adapted to this type of teaching, for an eight-week course of 40 teaching hours (100 hours total work), is as follows:

1. Course definition
   The instructor defines what to teach, that is, defines the learning objectives and specific educational contents of a course, which he or she publishes on a web page.
2. Learner's self-paced learning process
   - The learner enrols for the course by filling in, over the Internet, a form stating his or her previous knowledge and skills related to the educational contents and learning objectives of the course. The number of students is limited to 20.
   - The instructor automatically builds, on the basis of the form, the learner's learning process; that is, the e-lessons tree of the specific *self-paced learning process* for the learner. The knowledge that the learner already has related to the educational contents of the course is added as appendices to the e-lessons tree. This assures that all the learners have the same course documentation, even if their instructional method is different.

3. Course execution
   The course kicks off with a one-day face-to-face class where the learners have the chance to meet each other and the e-learning tutor. The tutor checks up on the group's knowledge, presents the learning objectives, discusses the most significant knowledge and tasks to be learned, and describes the interactions there will be through email, chat, and videoconferences.
   - Two 1-hour interactions between the learners and the instructor are held per week via chat to consolidate knowledge. The chat is held informally and its development is not structured.
   - Two computerised videoconferences are broadcast in the third and sixth week. To assure that they are efficient, the subjects to be dealt with are previously planned and structured.
   - There is permanent email support, which should be answered within the following 24 hours.
   - There is telephone support for 1 hour a day. Learners are encouraged to outline the subject via email previously.
   - Finally, if a diploma is to be issued to accredit having passed the course, a face-to-face assessment examination is set for all learners.
4. Self-paced learning process revision
   Depending on course development, the knowledge acquired and the partial objectives achieved by the learners, the instructor may modify the self-paced learning e-lessons tree during the course. Care must be taken in this process not to destabilise the learner's learning process.

Conclusions

With the integration of computers, and especially the web, into the education system, there has been a shift from centralised classroom-based education towards distributed e-learning courses that can be taken anytime and anywhere.

Research and development into this type of teaching has focused mainly on the implementation of technological resources and the definition of standards for sharing and reusing the learning objects. Less effort has, however, gone into defining instructional processes suited for this type of teaching, leaving their ad hoc design to the instructor. This has led us to define an instructional learning model as a guide for instructors to create the learner's self-paced learning process.

Furthermore, several authors have found that the most efficient teaching model is a blended approach, which combines self-paced learning, live e-learning, and face-to-face classroom learning. Our experience over several years has backed up this hypothesis and led us to present a specific implementation of a blended approach.

References

Bandura, A. (1977). *Social learning theory*. Englewood Cliffs, NJ: Prentice Hall.

Bixler, B. & Spotts, L. (2000). *Screen design and levels of interactivity in web-based training* [WWW document]. URL http://www.clat.psu.edu/homes/jds/john/research/ivla1998/ivla98.html (13th June 2003).

Bloom, B. S. (1956). *Taxonomy of educational objectives, book 1, cognitive domain*. New York: Longman.
Bransford, J. D., Sherwood, R. D., Hasselbring, T. S., Kinzer, C. K. & Williams, S. M. (1990). Anchored instruction: why we need it and how technology can help. In D. Nix & R. Sprio (Eds), *Cognition, Education and Multimedia*. Hillsdale, NJ: Erlbaum Associates, 115–141.
Clark, R. (1999). *Developing technical training*. Washington, DC: International Society for Performance Improvement.
Clark, R. (2003). *Building expertise. Cognitive methods for training and performance improvement*. Washington, DC: Book of International Society for Performance Improvement.
Clark, R. & Mayer, R. (2002). *E-Learning and the science of instruction. Proven guidelines for consumers and designers of multimedia learning*. San Francisco, CA: Jossey-Bass/Pfeiffer.
Craik, F. I. M. & Lockhart, R. S. (1972). Level of processing: a framework for memory research. *Journal of Verbal Learning and Verbal Behavior 11*, 671–684.
Cross, J. (2003). *The life and death of eLearning. Learning from worst & best practice*, E-Learning Conference, Manchester, 18–19 March.
Davies, D. (2003). *Design content for blended learning solution*, E-Learning Conference, Manchester, 18–19 March.
Donovan, M. S., Bransford, J. D. & Pellegrino, J. W. (Eds) (1999). *How people learn: bridging research and practice*. Committee on Learning Research and Educational Practice, Washington DC: National Research Council.
EC [European Commission] (2001). *Communication from the commission to the council and the European parliament: the e-Learning action plan*, Brussels, 28.3.
Gell-Mann, M. (1996). A commentary to R Schank. In J. Brockman (Ed.), *The third culture: beyond the scientific revolution*. New York: Touchtone Books, 167–180.
Good, T. L. & Brophy, J. E. (1990). *Educational psychology: a realistic approach* (4th ed.). Longman, NY: White Plains.
Govindasamy, T. (2002). Successful implementation of e-Learning pedagogical considerations. *Internet and Higher Education 4*, 287–299.
Hulm, C. (2003). *Implementing a blended approach with your e-Learning*, E-Learning Conference, Manchester, 18–19 March.
Jonassen, D. H. (1991). Objectivism versus constructivism: do we need a new philosophical paradigm? *Educational Technology and Research and Development 39*, 5–14.
Merrill, D. (1983). Component display theory. In C. M. Reigeluth (Ed.), *Instructional design theories and models: an overview of their current status*. Hillsdale, NJ: Erlbaum, 279–333.
Merrill, D. (1997). Instructional strategies that teach. *CBT Solutions*, November–December, 1–11.
Michell, L. (2001). E-Learning methods offer a personalized approach. *InfoWorld*, April.
Palloff, R. & Pratt, K. (1999). *Building learning communities in cyberspace: effective strategies for online classroom*. San Francisco, CA: Jossey-Bass.
Palloff, R. & Pratt, K. (2003). *The virtual student: a profile and guide to working with online learners*. San Francisco, CA: Jossey-Bass.
Pazos, J., Azpiazu, J., Silva, A. & Rodríguez-Patón, A. (2002). *A virtual classroom based on academic memories*. Proceedings ICTE2002 of Information Society and Education: Monitoring a Revolution, Badajoz, Spain, pp. 87–92.
Rumelhart, V. E. & Norman, D. A. (1978). Accretion, tuning and restructuring: three modes of learning. In J. W. Cotton & R. Klatzky (Eds), *Semantic factors in cognition*. Hillsdale, NJ: Erlbaum.
Thorne, K. (2003). *Blended learning: how to integrate online and traditional learning*. New Jersey: Kogan Page.
Saettler, P. (1990). *The evolution of American educational technology*. Englewood, CO: Libraries Unlimited Inc.
Schulman, L. S. (1999). Taking Learning Seriously. *Change Magazine 31*, 10–17.
Schulman, L. S. (2002). Making differences: a table of learning. *Change 34*, 36–44.
URL: INAP. Retrieved online November 11, 2003, from http://www.teleinap.com
URL: Line Zine. Retrieved online June 14, 2002, from http://www.linezine.com/elearning.htm