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Web Information System for *e*-Learning

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***Abstract*—**A suitable e-learning system management needs to carry out a web-information system in order to allow integrated fruition of data and metadata concerning the activities typical of e-learning environment. The definition of a "web information system" for e-learning takes advantage of the potentialities of Web technologies both as for the access to metadata present on the several platforms, and as for the implementation of courseware which make up the relative didactic environment. What information systems have in common is the technological environment on which they are generally implemented and the use of metadata in order to structure information at all cognitive and organization levels. In this work we are going to define a methodology for the implementation of a specific web information system for an e-learning environment.

***Keywords*—**e-learning, information systems, course management, web-based system.

I. Introduction

WITH the globalization of the knowledge offer and demand, it is now essential to allow individuals to have access to such resource anywhere in the world without having to physically move.

Considering the opportunities offered by the Internet in the field of education, our scientific contribution aims at describing a methodology for the realization of an information system based on distributed resource logic. Such logic allows the users to access competences and formative materials, available in other centres adhering to the web according to a federative model, from any web node.

It is a Web Information System (WIS) specific for an e-learning environment, through which it is possible to interchange and share distributed cognitive resources, promoting, at the same time, cooperation among the various actors involved in the formative process.

Such environment differs from the traditional "e-learning platform" as it allows to manage not only e-learning services, but also all those organization and information services of a distributed information meta-system.

The methodological approach for the development of a WIS system requires the acquisition of conceptual models referred to the organization and information systems and their integration.

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Starting from such integration, the WIS construction develops along the following steps:

- Definition of services and fruition meta-environment of the web-based information system;
- Acquisition, evaluation and return of information referred to goals, contents, learning paths and interactions among the actors of the formative process according to the product life-cycle logic;
- Adoption of reference standards for the processing, cataloguing, availability, maintenance, and re-use of the didactic objects;

Usability assessment of the services and products offered according to usability parameters of a learning-oriented system.

II. Web Information System Services for E-learning

The web-based information system is certainly the most suitable for managing e-learning processes, where the course/learning object delivery is carried out through the Internet on which the so called platforms are implemented.

In literature, many studies and recent researches can be found as for the definition of guidelines for the implementation of quality courses or for the evaluation of didactic material delivery environment. Furthermore, other works have also demonstrated the importance of taking into account new didactic models to be applied to the teaching/learning methodology, that is e-learning [1]. Such models, unlike the traditional ones, put the student at the centre of the training path and around him a set of resources (human, didactic, technological) turns aiming at maximizing the learning mechanism.

In designing an e-learning system we have decided to constantly pay attention to the needs of the system users, not exclusively referring to the "domain", to make technological choices suitable to carry out integration processes with other systems, and involve well trained human resources. This "learner-oriented" approach compulsory requires a WIS development for e-learning.

The architecture of a web environment for collaborative/cooperative learning must be first of all provided with all the services necessary to establish and stimulate a virtual community, whose participants share their specific knowledge and resources, each acting both as provider and as user of learning resources.

In the definition of such architecture it is necessary to take into consideration the categories of services typically available in a framework of web co-operation, services that can be

classified into information, management, delivery, communication, and assistance services.

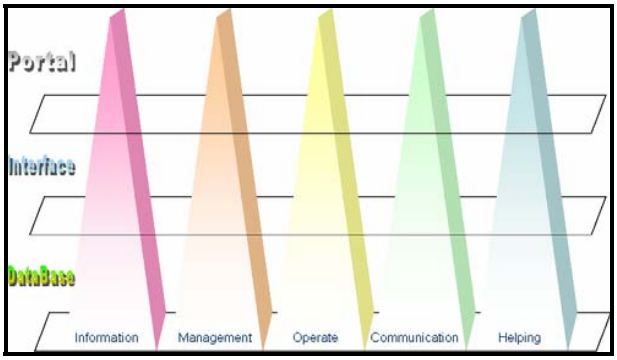

Fig. 1 Web Information System

Information services provide support for orientation within e-learning system through consulting functionality of the information resources such as databanks and interesting web-sites, innovation advertising sites and sites consulting curricula of the offered courses.

Management services collect and process the data concerning the course organization and tracing: user profile definition and recording, access statistics, content development and management, monitoring statistics.

Delivery services allow correct and exhaustive fruition on part of didactic content users: formative module publishing, on-line didactic material, evaluation tests and monitoring questionnaires.

Communication services are the tools which allow the exchange of information and communication of various kinds among the students and teachers/tutor in the virtual class, as a support for the collaborative/cooperative formative process. These services can be of "one-to-one" or "one-to many" type, synchronous and asynchronous, outwards messaging.

Helping services provide support for surfing within the course and the environments in which it is possible to ask for explanation and get answers through the automatic and semi-automatic user query answer system. These services can be, for example, assisted surfing, multilingual support, remote tutoring (messaging and FAQ), and research service.

Furthermore, the aware use of the collaborative/cooperative model within e-learning environments suitably adjusts itself to learning processes in which different cultural contexts are involved, guaranteeing its efficacy.

As for the "organization dimension" the e-learning system must undertake, this is carried out through the realization of a virtual context able to:

- facilitate forms of communication similar to natural communication;
- organize collaborative learning spaces and time;
- define the identity of the participants in the collaborative knowledge activities through customizing strategies;
- develop a shared theoretical and practical knowledge domain;
- implement tools and strategies for the demolition of linguistic barriers.

In order to guarantee environment adaptability to the user and to the different cultural contexts it is necessary to define, by pointing out new metadata typologies, some guidelines which can help the environment in the realization of a customized formative path.

III. Life-cycle of the e-learning Product

An important reference point in building a web information system for e-learning is the life-cycle of the e-learning system product, because it gives reference data about products, goals learning paths and interaction typologies among the actors of the learning process.

In the life-cycle the data are strictly pre-arranged and attention is focused on knowledge acquisition process and on dynamics occurring between the learner and the learning content [2].

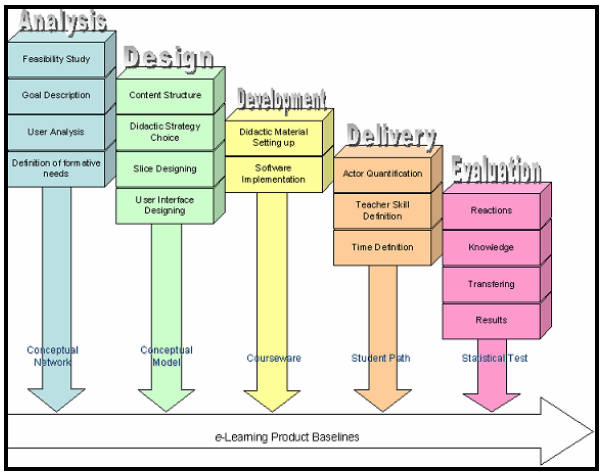

Fig. 2 *e*-Learning Life-Cycle

The formal model for the creation of an e-learning system is the result of an integration process between the software life-cycle model and a model of the Programmed Instruction, and is composed by the following steps [8].

Analysis:

- feasibility study;
- goal description;
- user analysis;
- definition of formative needs.

This step concerns the understanding and representing in a verifiable, readable and transferable way, of the information regarding the construction of an e-learning system.

All the requirements of the system must be considered and represented, whether they are explicit (deriving from customer documentation and interviews) implicit (not clearly declared, but necessary to reach the goals), or extraordinary (they make the system more efficacious). The conceptual network is the principal output of this phase.

Designing:

- content structuring;
- didactic strategy choice;
- slice designing;
- user interface designing.

This step uses the problem definition as a solution guide, manages the complexity of the problem by dividing it in solvable parts with the realization of components, uses tools, usually graphic ones, to make the project understandable, and offers a solution strategy.

The conceptual model is the fundamental document obtained during the designing.

Development:

- Selection and arrangement of didactic materials;
- Software implementation.

The development of the formative product processes the didactic model pointed out in the previous steps and carries out the courseware according to the standards defined in the project.

Delivery:

- Quantification of the actors;
- Definition of the teachers' skills;
- Time definition.

It is important to underline that the acquiring process must be controlled in order to avoid students' disorientation.

The system database stores all the data concerning the student path.

Evaluation on:

- reactions;
- knowledge;
- transferring;
- results.

This phase measures, in quality and quantity, the system convenience versus a traditional formative system [3]. Moreover, the data obtained from the evaluation allow to improve the product, particularly the usability [11].

Fundamental, at the end of the life-cycle, is the processing of the statistic tests.

Each step of the described process produces, as output, information used in the following phase and then it may improve the web information system database [6].

IV. Maintenance and Usability

For a learning-oriented system, which manages a great quantity of data and metadata and makes the interaction with the user a didactic tool essential and decisive for learning, it is important to take into consideration two fundamental aspects: data-handling and environment usability suggesting methods and techniques to be adopted in interface development [5].

The web defined methodological approach allows us to solve those problems of maintenance connected to the management of great quantities of data and metadata and which are referable to aspects of usability. It is therefore necessary to evaluate and solve problems referred to:

- **redundancy**: as it makes contents and their surfing too heavy;
- **inconsistency**: as it seriously endangers the whole learning process, making the student lose confidence as for the entire system reliability;
- **incompleteness**: as it does not guarantee a complete covering of the offered services;
- **actuality**: as not updated information risks making the system not suitable for the required education needs.

In order to guarantee integration, fruition and re-usability of the WIS system didactic objects, the adoption of a standard is necessary. In particular, we adopted the SCORM standard defined for the e-learning formative product realization.

Such standard, which gathers in one standard the various IEEE, IMS, AICC standards, specifies the standards for the tracing, cataloguing and re-using of the didactic objects, the so called Learning Objects.

The SCORM standard adoption is particularly important from the viewpoint of the data maintenance, as it solves problems connected to managing great quantity of data and metadata.

The reference methodology for the usability evaluation we have chosen is called SUE (Systematic Usability Evaluation), which systematically combines survey with empirical methods, taking advantage of the best characteristics of both methods and reducing the disadvantages.

The basic assumption of SUE is that an in-depth evaluation of an interactive application is given by various evaluation processes, each focussed on a specific dimension of the analysis. As well as the general principles of usability, each evaluation process must also take into consideration more specialized usability attributes, able to capture the characteristics of an application which are included in the dimension of the chosen analysis.

In the case of the e-learning web information system, it has been necessary to refer to the SUE specialization in learner-centred contexts of co-operative/collaborative type. With this aim, suitable guidelines were adopted, describing the activity that must be carried out and the application aspects on which the analysis must be focused in order to reach the degrees of suitability requested by the system [7].

V. Conclusion

The use of a web information system for an e-learning system management is a winning choice.

The advantages of such system are connected with time and money saving. In fact, in this way the management of the information system referred to the e-learning process is greatly facilitated by means of a well-defined web-based solution, in the product life-cycle, usability, and standard perspectives.

This system, thus implemented, has also the advantage of a high number of users who successfully conclude their educative path.

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