Jornada de Seguimiento de Proyectos, 2005
Programa Nacional de Tecnologías Informáticas

# MD2: Método para el desarrollo de materiales didácticos extendidos y su automatización TIC2003-03654

Paloma Díaz Pérez *
Laboratorio DEI. Departamento de Informática. Universidad Carlos III de Madrid

**Abstract**

The MD2 project aims at providing tools to develop extended learning materials. This goal is being addressed by means of three activities: (1) to define a method for the collaborative generation of learning contents; (2) to extend current learning object standards to incorporate concepts such as ontologies and adaptation to the context, and (3) to elaborate an evaluation framework for testing the usability and utility of educational applications. A specific platform will be developed to test practically all these goals. This document describes the project status after eighteen months of work as well as the main results obtained till the moment.

## 1 Project goals and resources

The impressive rise in the use of CBTs is chiefly due to the need for supporting lifelong learning at all educational levels as well as to the use of Internet as a distribution platform that allows didactic resources to be accessed anywhere and anytime. Even though a great of effort is being devoted to proposing standard mechanisms for creating reusable learning objects and courses in an easy and useful way by different international groups and organizations (including LTSC, ADL, ...), there are still some issues that need to be properly addressed as the ones that shape the objectives of the MD2 project:

O1 To propose **a method for the collaborative generation of learning contents**, offering a framework for cooperative knowledge production that will take into account different interaction styles with a view to improve efficiency and reduce conflicts and inconsistencies

O2 To **extend current learning object standards** to incorporate advanced features such as the metadata cohesion by using accepted and shared concepts (ontologies) and supporting hypermedia concepts such as the adaptation to the context.

*Email: pdp@inf.uc3m.es

| | UC3M | External Org. |
|---|---|---|
| **Doctor** | 4 | 2 |
| **Phd. Students** | 2 | 2 |
| **Undergraduate Students** | 2 | 0 |

Table 1: MD2 team

O3 To **elaborate an evaluation framework for a priori testing** of usability and utility of educational applications that will include a method and a number of criteria, parameters and metrics concerning the educational usefulness and the quality of the interaction mechanisms.

These three theoretical endeavours will be practically tested into a platform that will be developed with this purpose.

## 1.1 Project Resources

To achieve the goals stated above the project was assigned 6 EDPs. Team composition is shown in table 1. Most members have a technical background though experts in pedagogical issues are also collaborating to provide the necessary multidisciplinary view. These pedagogical experts are Dr. Cristina Laorden Gutiérrez from *Universidad de Alcalá* and Dr. *Valentín Martínez-Otero* from Centro Universitario Villanueva, both of wich are cooperating to define criteria and parameters making up the evaluation framework (O3).

## 1.2 Project Planning

At this moment there are no remarkable deviations from the initial planning shown in figure 1. Activities planned for the next eighteen months include: to improve the method for col-

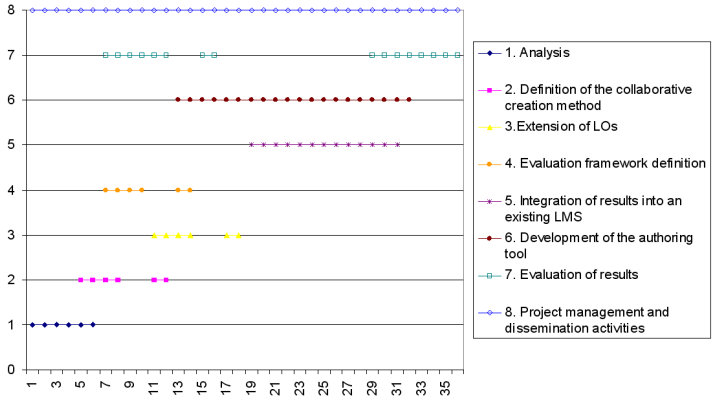


Figure 1: MD2 initial planning.

laborative authoring and the authoring tool based on evaluation results; to define a model of

dynamic adaptation for the units of learning (UoL); to define the criteria and metrics for aprioristic evaluation of learning material; to include meta-data related with aprioristic evaluation; an to integrate the authoring tool into an existing LMS.

# 2 Level of achivement

The study of the state of the art gave rise to the selection of the technological platform and standards with which we have worked out. Some results of this study have been:

- The selection of standard specifications like Learning Object Metadata (LOM), as well as structured descriptions like IMS Learning Design (IMS-LD)
- The incorporation of web services as a new technology that can drive a more efficient integration with learning systems and other related systems, in a more accesible fashion for end users, including companies who expressed their interest in the project results.
- The second goal of the project has been revised to a more complete but feasible one: the dynamic adaptation of units of learning to facilitate personalization of the environment to the students' profile, maintaining as well the semantic annotation as the basis for this goal.

The analysis activity is considered as complete, though new works may emerge in the future, whose relevance should be taken into account within the project goals.

## 2.1 A method for the collaborative generation of learning contents (O1)

A first version of the method has been devised, including the semantic annotation process as the basis to the generation and re-using of learning objects. This goal is not considered as finished, since the definition is incremental, to be continuously supported and evaluated by means of the corresponding software tool whose interface in shown in figure 2. In particular, to assist learning object authors in the collaborative creation process, an integrated development environment has being built, in which two major modules have already been developed and tested (see section 3.3). The results of using the method through that software tool will be used to improve and refine it iteratively.

## 2.2 Extension of the LO (O2)

Two different fronts have been tackled with respect to this goal:

- On the one hand, ontologies have been used to provide semantics to learning objects. Ontology annotations constitute the most basic mechanism of the authoring process. It is a process based upon the reuse of existing material and their semantic extension.
- On the other hand, there is a research effort on the adaptation of IMS-LD units of learning to different contexts, with the purpose of facilitating the reuse of didactic material in various situations, as well as to achieve the fitting of such material to the users' needs, so providing a dynamic and transparent adaptation to the user.

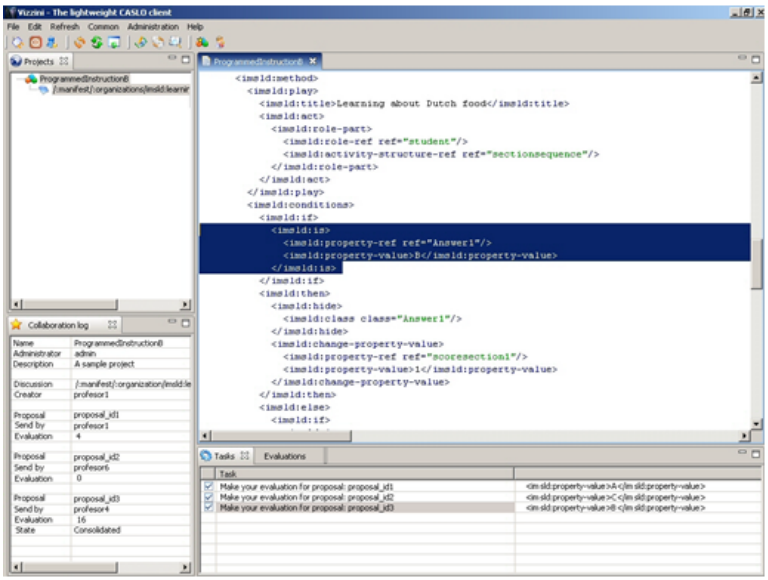

Figure 2: CASLO interface

In principle, the subject of extension concerned only hypermedia links. Nevertheless, since it has been extended to the adaptation of the educational process, this goal is not complete yet. The inclusion of ontologies has been carried out, but the adaptation of units of learning is still under ongoing. The main extension to learning technology specifications that has been provided is the way of integration of domain ontologies as learning object annotations [14, 22]. Another extension has been proposed, concerning the integration of decentralized learning service descriptions into a learning design specification [11]. Such extension will be subject of testing in the immediate stages of the project.

## 2.3 Apriori evaluation framework (O3)

A first analysis on the learning object evaluation model was elaborated, where the results were published in [1]. After some work with both software engineers and pedagogue experts (Dr. Cristina Laorden and Antonio Sarasa), such model and criteria were further elaborated, structuring the evaluation criteria into four dimensions: (1) *Technical criteria*, that assess the LO as a software object (interoperability, reusability, flexibility, etc.); (2) *Topic-specific criteria* that assess the LO as a piece of knowledge concerning a specific topic (eg. coherence, completeness, durability...); (3) *Pedagogical criteria* that assess the LO as a pedagogical resource (eg. learning goals, method, etc.); and (4) *Use criteria* that assess the LO as an interactive item (eg. presentation features, interaction, etc.).

Some preliminary works have been also carried concerning the formalization of elements from these four dimensions. In particular we are trying to translate criteria into elements of an ontology to describe explicitly the quality evaluation model of LO. An OWL-based ontology has been defined using tests based on the IMS QTI specification.

| | Int. Journals | Conferences | Invited Talks | Int. Awards | Thesis |
|---|---|---|---|---|---|
| **2004** | 0 | 5 [22, 4, 8, 2, 1] | 3 [7, 12, 15] | 1 | |
| **2005** | 4 [5, 14, 6, 16] | 7 [17, 11, 20, 10, 19, 9, 21] | 3 [18, 3, 13] | 1 | 4 |
| **Total** | 4 | 12 | 6 | 2 | 4 |

Table 2: MD2 mid-term results

# 3 MD2 mid-term resuts

This section summarises the main results of the MD2 project including a description of personnel in training, publications and thesis and, finally, cooperation with other groups.

## 3.1 Personnel in training

As indicated in table 1, there are four PhD students preparing their thesis in issues related to the project goals. Such students are: Telmo Zarraonandía Ayo (UC3M), Carmen Luisa Padrón Nápoles (UC3M), Jorge Torres (*Instituto Tecnológico de Monterrey*, Mexico) and Antonio Sarasa (*Universidad Complutense de Madrid*). Some undergraduate students are also preparing their minor projects including:

- Jesús Lanchas Sampablo is finishing his project, which consists in the software design and implementation of a web services-based collaboration server and a prototype authoring tool.
- Carlos Salguero is extending the authoring tool to provide ontology navigation on the subjects of collaborative annotation.

## 3.2 Publications

Table 2 summarises the main publications derived from this project in this 18 months. The members of the project have received two international awards directly related with their work in MD2:

- The subproject "CASLO: Collaborative Annotation Service for Learning Objects" was awarded as the IEEE TCLT Small Scale Research Project 2004 in recognition of its contribution in the area of learning technologies.
- Dr. Dodero was awarded with the IEEE TCLT Young Researcher Award 2005 in recognition of his work in the area of Advanced Learning Technologies.

In addition to the publications, the members of the team are supervising four thesis under development:

- Telmo Zarraonandía Ayo. "Modelo de adaptación de diseños de aprendizaje en tiempo de ejecución". Supervisor: Camino Fernández.
- Jorge Torres. "Un modelo de soporte a la composición y ejecución distribuida de objetos y servicios de aprendizaje". Supervisor: Juan Manuel Dodero.

- Carmen L. Padrón Nápoles. "Procedimiento generativo para el diseño de objetos de aprendizaje". Supervisor: Paloma Díaz.
- Antonio Sarasa. "Un modelo de calidad para la composición de objetos de aprendizaje". Supervisors: Juan Manuel Dodero and Alfredo Fernández-Valmayor (Universidad Complutense de Madrid).

### 3.3 Technology transfer

The first version of the main tools supporting the collaborative authoring have been developed and tested [6]:

- CASLO is a web services-based collaboration server used to coordinate and negotiate the collaborative development of learning objects [9]. It is the collaboration provider of the integrated learning object development environment.
- *Vizzini* is a thin client graphical authoring tool, which is used to provide and discuss annotations on a learning object [13]. The provision of collaborative annotations is carried over CASLO server.

The authoring tool provides raw access to all functions of the collaboration server on any kind of XML manifest-described learning object, as all learning technology standards provide. Nevertheless, editing facilities are being extended with specialized views for some learning object specifications, particularly for question and test items (QTI), and learning design (LD) specifications.

### 3.4 Cooperation with other groups

The MD2 team has established and strengthen several liaisons with different research groups and organizations as a consequence of its work in this project.

The MD2 team has contacted the members of the UNFOLD european project consortium made up of Universidad Pompeu Fabra, The Open University of the Netherlands (OUNL), and European Continuing Education Network. Cooperation with this consortium includes the participation is several meetings and events as reported above. Moreover, the potential integration of MD2 technological results into the RELOAD tool is being analysed with the members of UNFOLD project. Another line of work is the extension of learning design specifications to be able to incorporate decentralized learning services. For this aim, discussions have been taken with two main players in the learning design arena:

- Prof. Rob Koper, director of learning technologies R&D at the OUNL, who is responsible for the development of Educational Modelling Language (EML), which currently takes the form of IMS Learning Design Specification.
- Dr. Ernie Ghihlione, LAMS project manager at McQuarie e-learning centre of excellence (MELCOE), McQuarie University (Sydney, Australia).

Researchers Nora Helena Villa and Dora Inés Chaverra from *Facultad de Comunicaciones* and *Facultad de Educación* respectively of Antioquia University (Colombia) were cooperating at

the laboratory from october 2004 to december 2004.
The project team also cooperates with the IEEE Technical Committee on Learning Technologies. In particular, Paloma Díaz is vice-chair of the committee and other team members take part in different events including editorial boards and program committees.
A closer cooperation has been established with the *Ingeniería de Sistemas Hipermedia* group at U*niversidad Complutense* leaded by Prof. Dr. Alfredo Fernández-Valmayor to work in the area of usability criteria whose main result is the co-supervision of a thesis. The cooperation with this group and with Dr. Félix Buendía from Universidad Politécnica de Valencia has given place to a research project related with MD2 and prepared by both groups.

Other minor collaborations, mostly as expressions of interest about the results of MD2 project, were provided by Francesco Orciuoli, from the Centro di Ricerca in Matematica Pura ed Applicata, University of Salerno (Italy); and Cesar Moura, from the Université de Lille (France).

# References

[1] Sarasa A. and Dodero J.M. Towards a model of quality for learning objects. In *Proceedings of 4th IEEE Int. Conf. on Advanced Learning Technologies ICALT*, pages 822–824. IEEE Computer Science, 2004.

[2] Sarasa A., Dodero J.M., Díaz P., and Padrón C.L. Integración de ontologías de dominio en la anotación de objetos de aprendizaje. In *Actas del 6º Simposio Internacional de Informática Educativa SIIE'04. Cáceres, Noviembre*, pages 34–39, 2004.

[3] Padrón C.L. Learning web services composition and learner communities support for the deployment of complex learning proceses., September 2005. Learning Designers CoP at UNFOLD Barcelona Communities of Practice (CoP) meetings.

[4] Padrón C.L., Torres J., Dodero J.M., Aedo I., and Díaz P. Learning web services composition and learner communities suppor for the deployment of complex learning processes. In *Proceedings of 4th IEEE Int. Conf. on Advanced Learning Technologies ICALT*, pages 390–393. IEEE Computer Science, 2004.

[5] Padrón C.L., Dodero J.M., Aedo I., and Díaz P. The development process of learning material. *Computer Science and Information Systems*, 2005. Invited paper.

[6] Padrón C.L., Dodero J.M., and Lanchas J. CASLO: Collaborative annotation service for learning objects. *IEEE Learning Technology Technical Committee Newsletter,*, 7(2):2–7, April 2005.

[7] Aedo I. Tecnologías de la información para el desarrollo de materiales didácticos., Julio 2004. 7º Congreso Colombiano de Informática Educativa. Bogotá.

[8] Aedo I. and Díaz P. Tecnologías de la información para el desarrollo de materiales didácticos. In *7º Congreso Colombiano de Informática Educativa. Bogotá*, Julio 2004.

[9] Lanchas J., Dodero J.M., and Padrón C.L. Servicios web para la anotación colaborativa de objetos de aprendizaje. In *Actas de las Jornadas Técnico-Científicas en Servicios Web. Granada, Septiembre*, 2005.

[10] Torres J., Dodero J.M., Aedo I., and Díaz P. A characterization of composition and execution language for complex learnign processes. In *Proceedings of IASTED Int. Conference. on Web-Based Education*, pages 255–260, 2005.

[11] Torres J., Dodero J.M., Aedo I., and Zarraonandía T. An architectural framework for composition and execution of complex learning processes. In *Proceedings of Int. Conference on Advanced Learning Technologies ICALT , Kaohsiung, Taiwan, July*, 2005.

[12] Dodero J.M. De la integración de las TIC en el desarrollo de material didáctico, Octubre 2004. I Simposio Pluridisciplinar sobre Diseño, Evaluación y Descripción de Contenidos Educativos Reutilizables, Universidad de Alcalá (Guadalajara).

[13] Dodero J.M. The CASLO collaborative authoring system, June 2005. "Implementing the solutions session" at UNFOLD "Communities of practice meeting, Braga, Portugal".

[14] Dodero J.M., Aedo I., Díaz P., and A. Sarasa. Integration of ontologies into the collaborative authoring of learning objects. *Journal of Universal Computer Science*, 2005. accepted for publication.

[15] Díaz P. Las TIC en el proceso de enseñanza-aprendizaje, Mayo 2004. I Jornada Campus Virtual UCM. Universidad Complutense de Madrid.

[16] Díaz P., Aedo I., and Montero S. Applying flexible model processes in web development. *WSEAS Transactions on INFORMATION SCIENCE and APPLICATIONS.*, 2005. Accepted for publication.

[17] Díaz P., Aedo I., and Montero S. Web engineering in practice a development case. In *Proceedings of WSEAS International conference on Distance Learning and Web Engineering. Corfu*, 2005.

[18] Zarraonandía T. Context sensitive adaptations on learning design executions, April 2005. "Learning Design Research Colloquium" at UNFOLD "Exploring authoring tools for IMS Learning Design".

[19] Zarraonandía T., Fernández C., and Dodero J.M. Context sensitive adaptations on learning design executions. In *Proceedings of 5th Int. and Interdisciplinary Conference on Modeling and Using Context CONTEXT'05*, 2005.

[20] Zarraonandía T., Fernández C., Díaz P., and J. Torres. On the way of an ideal learning system adaptive to the leaner and her context. In *Proceedings of Int. Conference on Advanced Learning Technologies ICALT*, 2005.

[21] Zarraonandía T., Dodero J.M., and Fernández C. Adaptaciones al contexto en tiempo de ejecución de unidades de aprendizaje. In *Actas del Simposio Nacional de Tecnologías de la Información y las Comunicaciones en la Educación. Granada, Septiembre 2005*, 2005.

[22] Zarraonandía T., Dodero J.M., Aedo I., Díaz P., and A. Sarasa. Domain ontologies integration into the learning objects annotation process. In *Proceedings of Semantic Web for E-Learning Workshop at ITS'2004*, 2004.