THE ISSUE OF SEMANTIC MODELING OF THE LEARNING ORGANIZATIONAL MEMORY FOR E-LEARNING

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ABSTRACT: The development of open and long-distance learning – within universities but also within geographically distributed enterprises –has led to the development of researches focusing on modeling on semantic bases the learning organizational memory of an e-learning type. This paper reviews the literature in the field, focusing on defining a generic template of semantic modeling of the content of the learning organizational memory of the e-learning type, by proposing a study case of semantic representation of learning objects applied to the economic-financial analysis. The research is both theoretic and applied-deductive in character, starting from a general background regarding learning in general and reaching particularity by providing an ontology specific to the economic-financial analysis.

Key words: learning organizational memory, learning object, ontology, metadata, indexing, e-learning, modeling standards, economical and financial analysis.

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Introduction

The emergence of the IT and especially of the Web technology generated a new learning method called e-learning (or learning via electronic networks). This new learning method, using the IT infrastructures (Internet or Intranet) makes significant the issue of modeling the learning organizational memory of the e-learning type, to the extent of enabling archiving, updating, reusing, retrieving and accessing easily the learning resources. Several researches found a semantic component as regards the learning organizational memory of the e-learning type (Benayache, 2005; Lenne et al., 2005; Abel, 2004).

Various norms were defined in order to fully describe the educational resources listed, such as the LOM norm (Learning Object Meta Data) for describing learning resources, SCORM (Shareable Content Object Reference Meta Data) for structuring the content of objects and IMS-LD (IMS-Learning Design) for learning scenarios, Dublin Core for searching less complex resources (Hernandez et al., 2008).

Modeling on semantic bases focuses on using two types of ontologies: the generic ontology of the learning field (which describes the concepts of the "learning" field) and the ontology of the application field (which specifies the organization of the notions to be learned as regards particular learning). The modeling process involves three entities: general ontology, the ontology of the application field and indexing the related entities. The learning resources are indexed by means of the knowledge defined by using the two ontologies.

This research was carried out within the project called "Researches regarding modeling and designing organizational memory. OMCCAAF – a new methodological background for capitalizing on the cognitive acquis in the financial-accounting field", financed by CNCSIS, and focuses on defining a generic template of modeling on semantic bases the content of learning organizational memory of the e-learning type and applying it to representing learning objects with application to the economic-financial analysis.

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Research methodology

The research carried out within this paper is of a fundamental type, aiming at researching the semantic modeling of the learning organizational memory of an e-learning type. Another section of the research is of an applicative type, aiming at achieving the ontologies specific to the economic-financial analysis. By developing and exploring the idea theories within the e-learning field, one approaches the theoretic character of the research. Synthesizing the elements published in this field is based on an extensive analysis of the secondary literature, imprinting a deductive character to the research, starting from a general background, related to learning in general and becoming particularized by achieving an ontology specific to the economic-financial analysis

Literature review

Modeling learning organizational memory as regards the e-learning type is the subject matter of numerous academic publications (Bouzeghoub et al., 2005; Abel, 2007; Hernandez et al., 2008), as well as of research projects (the most often quoted in the secondary literature are the projects: Recre@sup, MEMORAe, Ariadne, Arpem, etc).

Reviewing the literature focuses on two significant dimensions:

- The conceptual bases of modeling learning organizational memory;
- Norms for representing learning resources

Conceptual bases

The works treating e-learning operate mainly with the following concepts: learning objects, metadata, ontologies, learning scenario, learning organizational memory and repository of learning objects (fig. no. 1).

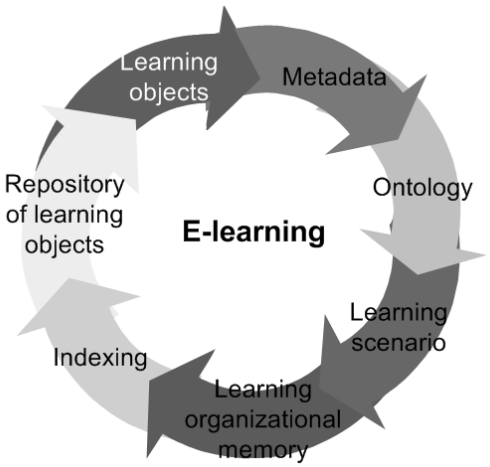

Fig. no. 1 – Concepts use in e-learning domain

Learning object. The concept of learning object is crucial in organizing and using the e-learning memory. The resources of the learning process form learning objects. A learning object is a semantic unit of the learning resource. The IEEE-LTSC (Learning Technology Standards Committee) working group defines the learning object as *either a numeric or not unit which may be used, reused or referenced within a learning program, based on a technological support* (IEEE, 2002). According to Beck (2001), learning objects provide a new concept to the learning process, supplying reusable learning units, which may be considered electronic documents created for the purpose of being integrated into a technological background dedicated to e-learning. These may be lessons, exercises, subjects of assessing knowledge, case studies, etc. A learning object may include basic elements such as images or documents, or may be formed of other learning objects.

The group of studies "Survey of Educational Modeling Languages" classifies the learning objects in three classes:

- *learning units*, which allow structuring learning and organization in space and time;
- *learning activities* defining precise means of acquisition, validation and communication of one or several pieces of knowledge;
- *physical or numerical learning resources*, required for carrying out activities.

The learning objects have the following properties (Bourda, 2001):

- autonomy, every object may be used independently of the others;
- reusability, a basic learning object may be used in different contexts and for multiple purposes;
- aggregation, learning objects may be regrouped;
- indexing, every learning object has a description that allows its being easily retrieved.

Ontologies. It is considered that in order to carry out an exchange of information, one should use a common vocabulary, being necessary to use an ontology in order to design and manage the learning organizational memory. An ontology regroups the concepts representing the entire knowledge in a specific field into an explicit and formal specification (Studer et al., 1998). By e-learning, we delimitate an ontology specific to the e-learning field (fig. no. 2) and a specific application ontology (fig. no. 3).

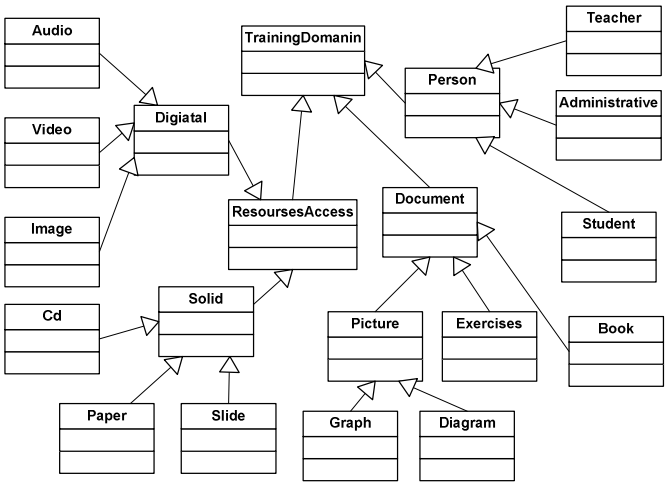

Fig. no. 2 – Extract from the domain ontology
Source Adapted from Benayache (2005)

The construction of the application ontology (a formal structure representing the knowledge in the specific field) becomes crucial for constructing e-learning systems. Such an ontology may be used later on as a support for reasoning operations, within semantic indexing processes and for facilitating access.

The description of an ontology is based on three different norms: RDF (Resource Description Framework), OWL (Web Ontology Language) etc. Constructing the ontology is widely debated in the secondary literature. It is based on the expertise of the trainers and numerous resources (books, courses, websites etc). Chrisment et al. (2006) proposes a methodological approach to transforming a "thesaurus' into an ontology, starting from two informal knowledge sources, namely the one coming from "thesaurus" and the one coming from the model documents.

Learning objects should be described by means of the theme treated, based on an ontology specific to the field of activity.

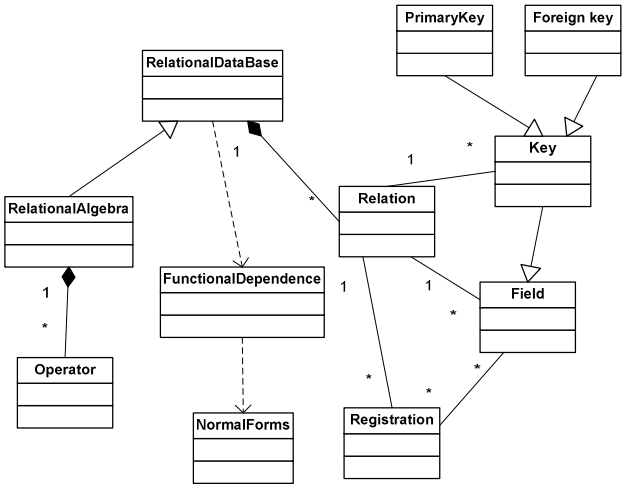

Fig. no. 3 – Extract from a specific application database ontology
Source: Adapted from Hernandez (2005)

Metadata. The term of 'metadata' refers to a structured complex of descriptive data serving to describe a source of information or knowledge. A note containing metadata is formed of a set of attributes and their value, useful for describing a resource (Abel, 2004). The notes are added to learning objects in order to make them identifiable, shareable and usable. The scientific community is interested in defining standards for describing resources using metadata. Among the standards for describing resources related to the education field, we should mention Dublin Core Education and Learning Object Metadata.

Indexing learning objects. Indexing learning objects is indispensable; otherwise, the learning object may not be retrieved. Other advantages provided by indexing are accessibility, searching, sharing and reusing. In order to index learning objects, it is necessary to determine characteristic ontologies, and to use some formalism to represent them (Abel, 2004). The user shall navigate within the application ontology in order to access indexed learning objects, with a view to acquire the learning knowledge.

Learning organizational memory. "Learning" may be construed as an organization within which various actors (trainer, learner, manager, etc) manage and use information, documents and knowledge by means of an organizational memory based on the so-called "learning" ontology (Abel, 2004; Fontaine et al., 2006, Benayache, 2005). Such a memory may be considered an explicit and persistent representation of knowledge and information within an organization, in order to facilitate their being accessed and reused by the organization actors in carrying out their tasks (Barthes et al., 1999). The learning content of a learning organizational memory is formed mainly of the notions that should be learned in the learning process and indexed documents (that help one to learn the relevant notions). Modeling a learning organizational memory is based mainly on defining and sharing an ontology (Leblanc et al., 2007). It involves three entities: the field ontology, the application ontology and indexing the related documents.

The repository of learning objects represents the technical solution to managing the learning organizational memory of the e-learning type (Abel et al., 2003; Iles, 2008). According to Inmon (2002), a data repository is *a collection of subject-oriented data, integrated, filtered, non-volatile and historicized, organized so that to support the decision-assisting process.* As regards e-learning, the data repository allows the capitalization on learning objects and any information related to learning objects that may be useful to users.

The learning scenario. We define the learning scenario as the result of the process of designing a learning activity. Designing a scenario is a systemic process allowing one to reach a

certain quality, by taking into account various factors influencing learning. Brassard & Daele (2003) point out 17 dimensions required for developing a scenario, regrouped into four categories: orientation and initial learning choice, actors and roles, activities, instruments and processes. The scenario of the learning use of memory is not established *a priori* (Abel et al., 2003). It is, in general, determined by the trainer in charge. It may be, however, negotiated between various actors in the training process. The conclusion is that the manner of structuring the learning organizational memory depends on the scenario retained.

Norms for representing learning resources

Normalizing bodies and academic research milieus found that a coherent and normalized approach is required as regards the description of learning resources (Abel, 2004; IEEE, 2002; IMSLD, 2003). Applying norms within the e-learning field ensures the interoperability and quality of systems used in this field.

Researches in the field point out the following norms:

- LOM or Learning Object Meta Data (IEEE, 2002) as regards describing learning objects by means of a set of meta data (it does not include however the semantic representation of contents);
- SCORM or Sharable Content Object Reference Model (SCORM, 2004) as regards describing the content of learning objects and their relations with the using milieu;
- IMS-LD or Instructional Management System Learning Design (IMSLD, 2003) as regards learning scenarios.

The LOM norm. The Institute of Electric and Electronic Engineering classifies the LOM metadata in nine categories:

- *general*, containing information describing learning objects as a whole;
- *life cycle*, containing characteristics related to the history of evolution and the current status of the learning object;
- *meta-metadata*, grouping information about instantiating metadata;
- *technical,* containing technical requirements and their technical characteristics;
- *educational*, grouping learning and learning characteristics;
- *rights*, grouping the rights of intellectual property and the conditions the learning object is subject to;
- *relations*, containing elements defining the relations between learning objects;
- *annotations*, providing information about the mode of using them and comments added;
- *classification*, describing the learning object related to a certain classification system.

The SCORM norm. It was proposed by Advanced Distributed Learning (ADL), and its purpose is to implement an adequate structuring of the content of learning objects and the interactions with their environment. Structuring the content according to the SCORM norm ensures interoperability. The whole of knowledge is represented by means of an ontology. Relations between concepts are introduced. SCORM specifications are defined in three main documents (ADL, 2003):

- The SCORM content aggregation model defines the manner of representing and structuring the content, so that to be used within any e-learning platform;
- The Run-Time Environment defines the requirements of using the content;
- Sequencing and Navigation defines the modes of managing and accessing the objects that form a learning object.

The IMS-LD norm. It was designed in order to standardize defining learning and interaction scenarios for content designers. By modeling, one answers questions such as: *Who and what does it? By using what resources?* and *What services are needed for achieving learning objectives?* In order to answer these questions, it is necessary to describe the users and their roles,

as well as the activities carried out within scenarios, which may be in the form of any type of learning resource (test, assessment exercise, direct interaction between student and tutor, etc), as well as the context of using the learning object within every learning activity.

A model of representing learning objects should integrate elements specific to the three norms, in order to specify the level of approaching the learning objects (by using the LOM metadata), the use within various field (by using various pieces of information), the prior knowledge and competences and use in various contexts (fig. no. 4).

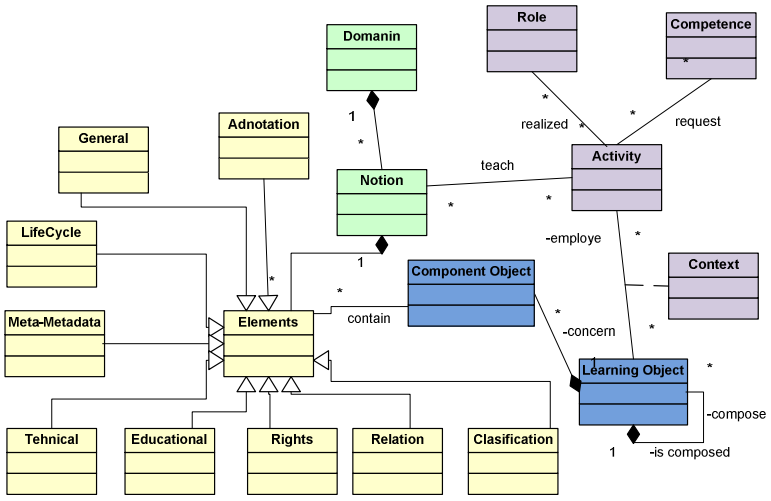

Fig. no. 4 – Model representation of learning objects in its context of use
Source: Adapted from Hernandez et al. (2008)

According to Hernandez et al. (2008), the semantic representation and use of learning objects (fig. no. 5) involves having knowledge about:

- resources (LOM norm) and object structuring (SCORM norm);
- the theme approached by the object;
- the whole of existing educational theories;
- learning scenarios (IMS-LD norm).

This knowledge is best represented by means of ontologies.

The ontology of the field allows the representation of learning objects against the themes or notions approached. Learning objects are indexed starting from the concepts of the field ontology and respectively the theme, describing the themes approached in the given field.

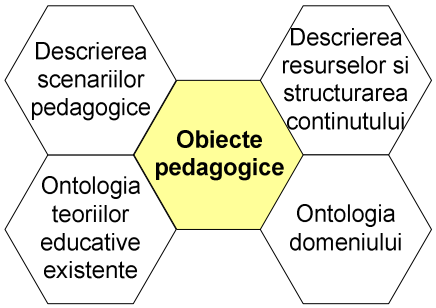

Fig. no. 5 – General model of learning object representation.

Modeling the learning organizational memory: the case of economic-financial analysis

This section presents specific elements of modeling the learning organizational memory applied to the field of economic-financial analysis. Our research focused on defining the ontology of the application field. As presented in the first section, defining application ontology becomes crucial in designing e-learning systems. Indexing and accessing learning objects on semantic bases is possible by means of the concepts within the application ontology. Based on concepts specific to the field of economic-financial analysis (Dinu, 2000; Georgescu & Robu, 2001), we propose the following application ontology (fig. no. 6).

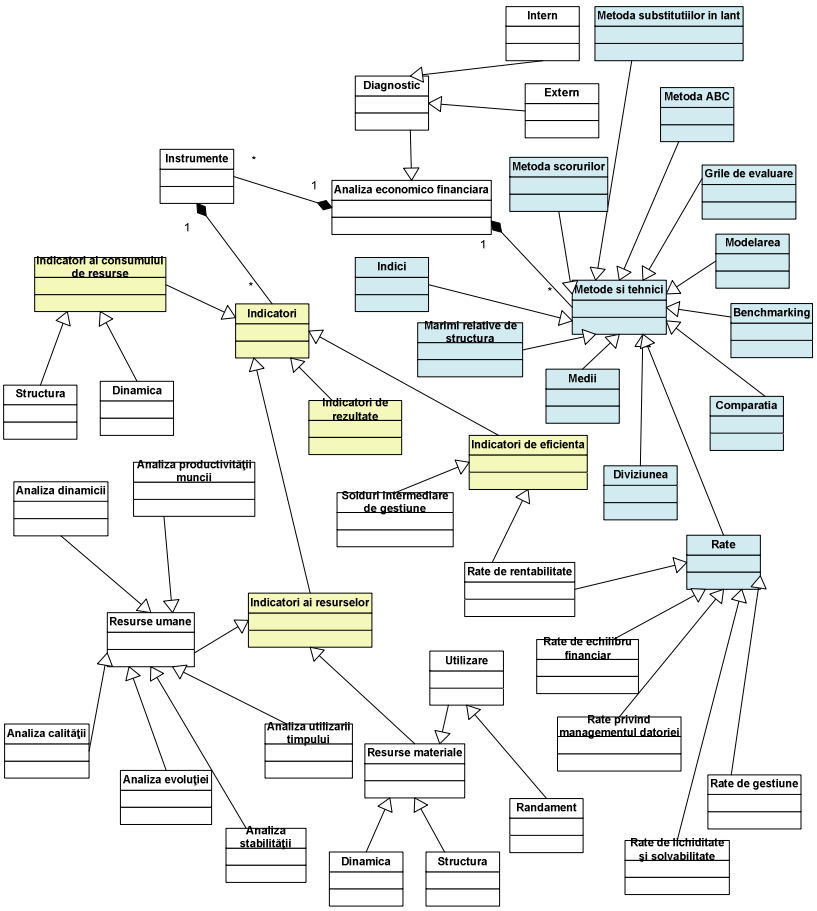

Fig. no. 6 – Extract from the ontology for economical and financial analysis domain

In order to develop the ontology specific to the field of economic-financial analysis, one should identify and analyze the main concepts and notions used in this learning field, making afterwards a hierarchic classification of them. Using a complex of *methods, techniques and tools* allows making a pertinent analysis of the activity of the enterprise. The secondary literature (Georgescu & Robu, 2001; Dinu, 2000; Isfanescu et al., 2009) presents the most used tools in economic analysis, in the form of *indicators*, whereas as regards *methods and techniques* one may identify the *division and comparison of results, benchmarking, grouping, modeling, graphic representations, assessment criteria, the ABC method, scores,* etc.

Dinu (2000) groups the indicators into:

- (material, financial, human) resource indicators;
- resource consumption (expenses) indicators;
- result (effects) indicators;
- efficiency indicators.

Conclusions

In this paper I reviewed the issue of semantic modeling of the learning organizational memory as regards e-learning, and exemplified with the case of economic-financial analysis. The association of semantic level as regards organizational memory resources opens new prospects for designing efficient e-learning systems, allowing the actors an easy access to the learning memory and developing learning scenarios.

An issue such as the automation in designing ontologies and representing them remains to be further researched.

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