Dynamic E-Learning Settings Through Advanced Semantics:

The Value Justification of a Knowledge Management Oriented Metadata Schema

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Knowledge exploitation in the modern era is recognized as a critical phenomenon. Several approaches (Kim & Mauborgne, 1997; Neef, 1999; Carter & Scarbrough, 2001) reveal the potential of knowledge to empower the capacity for effective action. The development of dynamic learning environments requires a systematic justification of methods and processes that promote varied learning (offer a unique value proposition) for every learner. To this end a number of e-learning techniques (Ruttenberg, Spickler, & Lurie, 2000; Bryans & Smith, 2000) appear to present a common approach with uncertain performance (Lytras & Pouloudi, 2001a; Lytras & Pouloudi, 2001b; Lytras & Doukidis, 2000). This challenging situation sets a context that promotes the research in reusability of knowledge resources. A realization of reusability can be based on semantics that enrich general knowledge resources (e.g., an article, a journal paper, a PowerPoint *presentation, etc.). The ultimate objective is to expand the customization capabilities of learning environments and knowledge management appears to be a well-justified means for the achievement of such a goal (Lytras & Pouloudi, 2001c; Lytras, Pouloudi, & Poulymenakou, 2002).*

Our research unit, Eltrun (www.eltrun.aueb.gr), has participated in several projects concerning knowledge management and learning over the last five years, and more specifically distance learning, life long learning, and workplace learning. This context creates many stimuli daily for deeper understanding of what it means to provide learning content, which is not only of high quality but incorporates layers of exploitable value.

The initial skepticism of the relation that integrates knowledge management and e-learning forced a very focused literature review of knowledge management approaches. The two basic approaches of knowledge management (KM) according to (Mentzas, Apostolou, Young, & Abecker, 2001) are:

- ***The knowledge processes approach*** where a number of well defined, more or less distinct but integrated, processes describe the knowledge activities that realize the continuum of tasks that require an extensive cognitive motivation.
- ***The knowledge artifact approach*** where the phenomenon of knowledge management is focused on the construction of knowledge as a building block for further exploitation.

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This distinction of approaches is not mutually exclusive in the sense that the first approach does not cancel the effect of the second. Especially in the case of learning there is evidence that a number of processes formulate the learning context and also that a kind of learning product is transferred and exploited. So our analysis investigates modes of integration. In this manner our knowledge management orientation tries to set a framework where a descriptive knowledge management life cycle model provides a value adding step-based approach for the construction of learning objects.

The establishment of e-learning systems within business settings or academic institutions is something similar to fashion. Many models, many different types, many markets, many interest groups, different degrees of satisfaction, and many users looking for customized solutions (Urdan & Weggen, 2000). Unfortunately the e-learning market is not as mature as needed in terms of effective solutions, advanced functionalities, and learning standards.

The analysis of the e-learning market in Europe as well as in the US is not only difficult but it has to be based on issues closer to effectiveness than to population increase. In most cases in virtual universities, the e-learning systems base their functionality on a simple browsing mechanism accompanied with a section of web links and a few online quizzes. In other words, the value of such a system when in most cases the employment of the ICT's is limited to a static learning scenario is questionable. We could state that these systems secure the growth of the so-called distance-learning marketplace in Europe even though the learner satisfaction from such a system is very limited. A critical question is: can we enhance the learner satisfaction on an e-learning system? If not, the learner's first impression will be negative. The mass of integrated e-learning platforms appears to be unable to support different degrees of value delivery. They appear to construct their powerfulness over common characteristics that in general simulate the traditional way of teaching. So a number of critical questions emerge:

Does e-learning differentiate from the traditional learning? Can we define concrete ways of content enrichment in virtual environments, which add value in traditional learning content, and support dynamic learning settings? Can we justify theoretical foundations that prove the different value layers of learning efforts? Can we test the ability of learning environments to support different educational goals through the employment of different learning processes? Can we develop learning environments capable of supporting the intellectual capital exploitation both in academic and business environment? Finally, can we formulate a framework that will support the application integration in a manner that will take into account the learning needs of business units? In other words, can we define an application layer within business intranets that will establish knowledge management architecture?

Our experiences from various projects related to e-learning can be summarized in Figure 1 (Lytras & Pouloudi, 2001c). The *learning effectiveness*, a concept with various quality factors included, has a direct relation to the *technological complexity* of the e-learning environment. The distinction of five relevant learning paradigms is not only a theoretical value hierarchy that formulates a contextual setting for analysis. It also provides an indication of the inability of many e-learning initiatives to be effective for trainers and trainees.

The five learning paradigms that deliver different levels of value are depicted in Table 1.

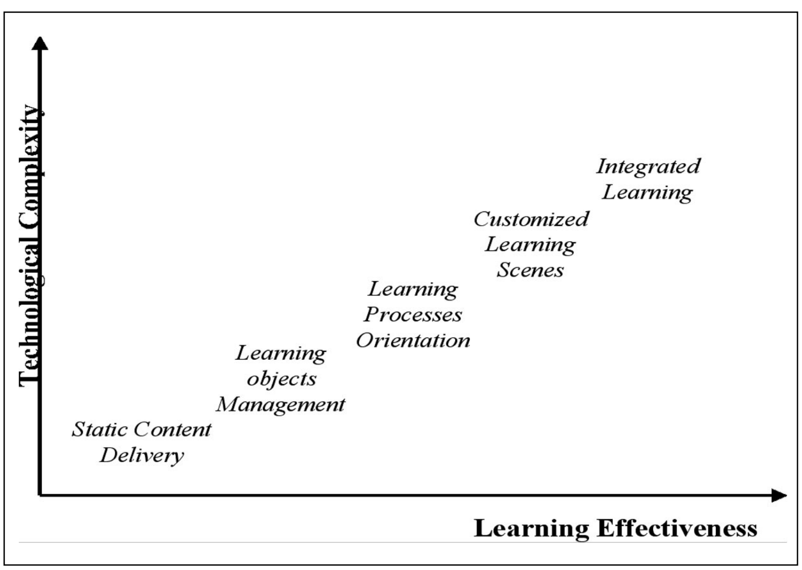

Figure 1. The e-learning paradigms evolution

Reusability of learning content and metadata

A major problem in the learning industry is the inability of the dominant e-learning platforms to support knowledge management mechanisms. This causes a number of limitations in the implementation of learning scenarios. Our research intends to justify a metadata schema and a correspondent logical schema in XML that supports a dynamic e-learning environment. The current situation on metadata is described by a narrow vision of learning. The analysis of dominant metadata schemas that follows appears to be inadequate to exploit learning content.

Two basic problems concerning learning content are codification and diffusion. Traditional knowledge management approaches (Boisot, 1987; Hahn & Subramani, 2000), promote critical guidance for the understanding of how these two problems can be solved. Diffusion basically incorporates two dimensions; the carriers of content, and the learning scenario. Packaging of learning objects in operational modules or logical settings with relevant value for learners provides an integration of the two facets of key issues. XML language makes the packaging of learning content more flexible as it provides enormous capabilities for Document Type Definitions, or in simple words a design language for the description of structure of documents or knowledge resources in general. This ascertainment, and the whole path of syllogism can be summarized in the following questions:

H1: Is there a way for the enrichment of knowledge resources that parameterize a dynamic learning environment?

H2: Can we exploit the knowledge management theories of knowledge life cycles to present a constructive development of learning content?

H3: Can we justify a way for the packaging of learning content according to a knowledge activities perspective?

H4: Is there a metadata schema that is oriented to the knowledge activities and the learning exploitation?

The case of reusability of learning content is an open issue for the academic community (Zack, 1999; Abecker, Aitken, Schmalhofer, & Tschaitschian, 1998; Tautz & Gresse, 1999; Mentzas et al., 2001). It appears that a hidden convergence formulates a holistic approach. The cornerstone in this approach is the description of a common standard that supports the enrichment of digital content with metadata or semantics. Our research effort goes a step further. It investigates the justification of a learning objects metadata schema that innovates in two ways: first, it elaborates the knowledge management theories and second, it uses learning objects hierarchies (Bloom & Krathwohl, 1984).

Research Methodology

In the last few years, the case of e-learning or distance learning, appears to have gained significant importance in the Information Technology scientific community, and in knowledge management circles. Many tracks in conferences, special issues in journals, and well known scientific journals discuss the current thinking and research findings. In the general literature of research methodologies in information systems many approaches can be found, which in general can be placed among the qualitative or in the quantitative research methodology.

The qualitative research is contradistinguished with quantitative research, as these two fundamental research methods are positioned on the extreme edges of a continuum. An interesting definition provided by Strauss and Corbin (1990) claimed that the qualitative research is "any kind of research that produces findings not arrived at by means of statistical procedures or other means of quantification."

Qualitative research is using qualitative data, which are collected using techniques that range from interviews, observational techniques, such as participant observation and fieldwork, to archival research. Written data sources can include published and unpublished documents, company reports, memos, letters, reports, e-mail messages, faxes, newspaper articles, and so forth (Myers, 1997).

In relation to education and learning, where its social character is an integral feature of the phenomenon, qualitative research appears to be more suitable as the learning performance is less quantitative and more observed in qualitative characteristics that can be revealed through interpretation of behavior and change of perceptions (Hoepfl, 1997).

Table 1. The Technological Characteristics of the Five E-Learning Paradigms

STAGES OF E-LEARNING EVOLUTION	MAIN CHARACTERISTICS
1. Static Content Delivery	Content selection, Html Authoring
2. Learning Objects Management	Knowledge Base, Metadata, Value Components
3. Learning Processes Orientation	Learning Processes Specification, Pool of LP
4. Customized Learning Scenes	Learning Needs Recognition, Learners Profiling, Learning Styles, Learning Paths
5. Integrated Learning	Application Integration, Corporate Portals

Miles and Huberman (1994) described qualitative research as simply, research based upon words, rather than numbers. Denzin and Lincoln (1998) provided a more generalized definition for qualitative research "Qualitative research is multimethod in focus, involving an interpretive, naturalistic approach to its subject matter." This definition implies that qualitative researchers study things in their natural environment and understand events in terms of the meaning people assign to them. This perspective provides a clear direction to our research since we decided to study three implementations of e-learning systems that have been analyzed, designed, and implemented in real world situations.

Benbasat, Goldstein, and Mead (1987) also found similar benefits of qualitative research and listed them as: (a) the researcher can study information systems in a natural setting, learn about the state of the art, and generate theories from practice; (b) the method allows the researcher to understand the nature and complexity of the process taking place; and (c) valuable insights can be gained into new topics emerging in the rapidly changing information systems field. The case of e-learning is very interesting to be studied in its natural environment even though the number of actors that are engaged are multiple. But the qualitative techniques permit the researcher to investigate the complexity of the phenomenon. E-learning is usually treated as a simulation of methods used in traditional education, and this habit limits the creative use of information technology. The complex nature of e-learning and the multidisciplinary influences that force new considerations for effectiveness and performance set a challenging research agenda.

The work of Hoepfl (1997), summarized the basic characteristics of qualitative research that are pointed out in research works of several other researchers (Bogdan & Biklen, 1982; Lincoln & Guba, 1985; Patton, 1990; and Eisner, 1991). According to Patton (1990 p. 55), qualitative research uses the natural space as the data source that is interpreted later on. The researcher is trying to observe and to describe the situation under a specific attitude that Patton described it as "empathic neutrality."

On the other hand, there are also disadvantages associated with this type of research, which include the fact that qualitative data is usually predominantly textual, with a richness that can be lost when aggregation or summarisation occurs. The data can be fairly unstructured and unbounded as it concerns people's behavior and attempts to understand their perception of a particular situation. Lee and Fielding (1991) also identified the disadvantages of qualitative analysis as "a lack of- controllability, deductibility, repeatability, and generalizability." Despite the disadvantages that were described the qualitative research was chosen in our research due to its appropriateness for the research context. The research strategy focused on the multiple case study method.

One of the most important research objectives in our research is to illustrate and discuss the empowerment that knowledge management provides to the codification of knowledge objects, for their use in an e-learning environment as learning objects. The other aspect of this objective is the specification of modes that provide the packaging of knowledge objects to learning scenarios capable to provide dynamic mechanisms for the diffusion of learning content. In the course of justifying the codification and packaging techniques for learning content there is a two-fold context: on the one hand the supply side where there are strongly articulated requirements to aggregate content and knowledge and on the other hand the demand side where learners demand flexible and customized mechanisms to interact with the technology supported learning environment. The learning performance and the effectiveness, especially in the case of adult learning, appear to be a more subjective rather than objective phenomenon. In other words, quantitative methods are rather inadequate to explore findings in depth, since the complexity of learning requires investigation of behavioral aspects, which are not quantitative in nature.

Moreover, the analysis of our research problem and the justification of our research methodology can be supported by the concepts, which Klein and Myers (1999) proposed. The hermeneutic cycle and its basic emphasis on the complementarities of a phenomenon and its components promote the basic idea that a phenomenon such as e-learning has to be analyzed through the distinction and the integration of the various variables that affect the whole system. In our approach distance learning, and especially e-learning is treated as a phenomenon where technology, knowledge management, and pedagogy intersect to promote higher cumulative value. In this triptych each part demands special analysis and promotes an integrated support to distance learning.

Our preconception that knowledge management is a critical pillar of e-learning performance sets the basis for further analysis. For this reason, we set a context of analysis by selecting three case studies which involved the implementation of e-learning systems. In this way the proposed historical context that is required, according to Klein and Myers' principles, is evident. From this point of view our participation in a number of e-learning implementations provided a first insight to the problems and key issues concerning e-learning.

The variables that have been mentioned, namely, technology, knowledge management and pedagogy intuitively promote the objectives of e-learning. From this point of view we add one more parameter to the whole research picture: the way in which the codification of knowledge and learning content increases the reusability of learning content and the way in which this reusability is realized through learning objects with embedded learning value. The concept of metadata, data about data, according to a simple definition, is a concept used in our analysis to enrich the general descriptive model that was presented in Figure 1.

The proposition of a metadata schema oriented to the phases of the life cycle model that was presented earlier, set a context of analysis in which the opinions of people involved in e-learning implementations provide evidence. This is why the value that is attached to each knowledge object by the knowledge providers builds an incremental learning value.

The case studies in our research are:

1. the Global E-management Master e-learning system and especially the development of the T1 course entitled E-technology, which was delivered to the student of the GEM consortium,
2. the XEXO project (Educational space without limits), where the objective was to establish an e-learning system and to deliver a masters degree course to the students of three universities in Greece, and
3. the Teleducation Center of Athens University of Economics and Business which utilizes the WebCT platform to provide learning content to students.

The fact that in distance learning the typical process is the selection of some knowledge objects and their adoption to be transferred through a technology supported environment poses a number of critical questions:

- How is the knowledge selected from various sources to comprise learning content?
- How is the knowledge codified and how is it adopted and finally transformed to learning objects?
- How is motivation realized on e-learning settings?
- How are different educational goals achieved in e-learning?
- How is the reusability of learning objects secured?
- How is a typical learning scenario in an e-learning implementation organized and to what extent is the information technology exploited for dynamic and personalized features?

The above questions provide a context of dialectic in which the theoretical propositions have to be integrated with prospects and interpretations of actors in e-learning implementations. The research methodology of our approach is presented in Figure 2. It describes a brief overview of the phases of our work, to achieve our overall research goal: to provide a knowledge management perspective to e-learning implementations, and ultimately to set technological standards in XML for the description of learning content that can be promoted through dynamic learning scenarios rather than hierarchical organization of learning content.

A Synopsis of Conceptual Abstractions

The organization of knowledge in distinct objects, small structural components, is the basis of reuse. In the case of customized learning the same learning content can be used in many ways due to its integration with other knowledge objects (Figure 3).

Our approach is based on two clear assumptions that initiate the whole research:

1. A learning object is a synthesis of knowledge and metadata that further expand the learning effect of knowledge. From this perspective an e-learning environment has to use a learning objects base. A critical question is: which metadata can we use to increase the learning effectiveness?

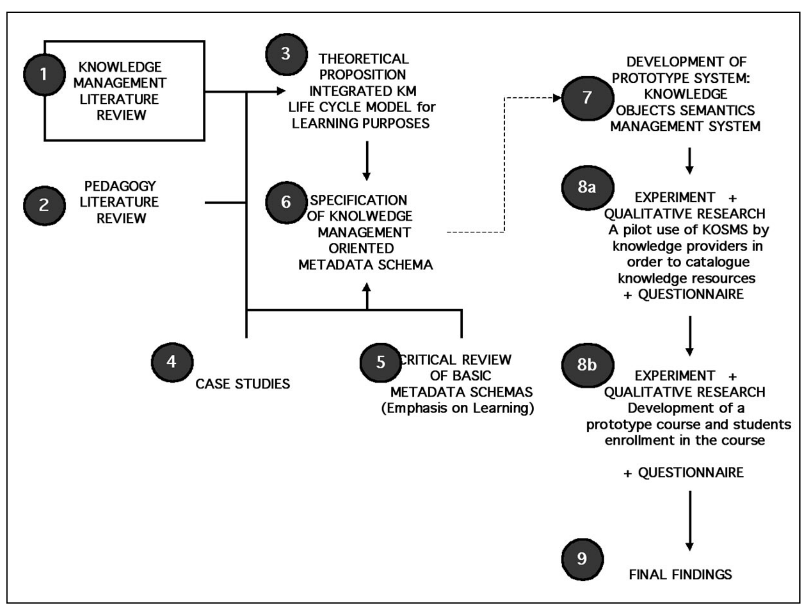

Figure 2. The research path

2. A learning process is an abstraction of a logical sequence of learning activities or tasks. The conceptualization of a learning process determines an interface in which the components of a learning object can be realized. This layout is a value container, which is used by the embodiment of a learning object. The critical question is, which learning processes can we use? And, is there any hierarchy of learning processes that determines different value layers?

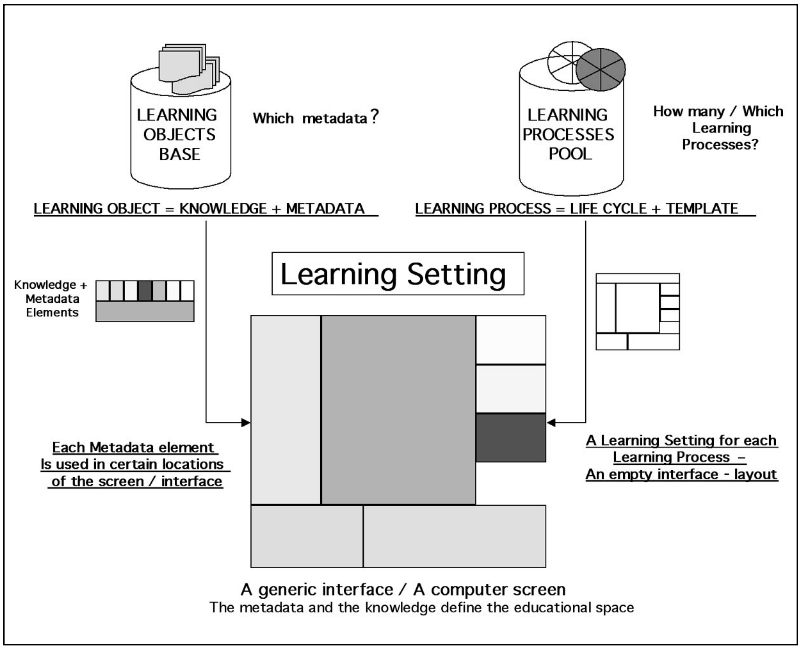

Figure 3. The basic conceptual abstraction

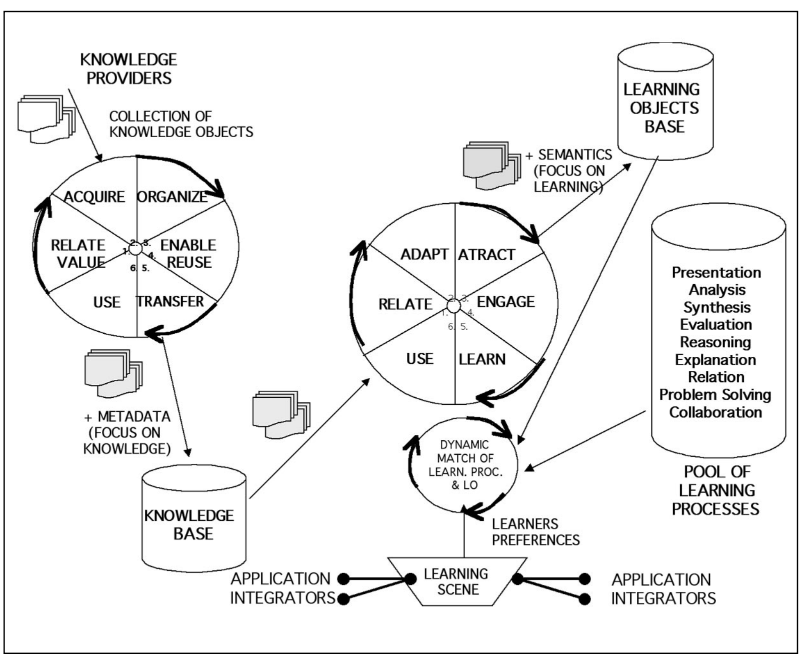

Figure 4. The Interchange Knowledge Flow

Reusability of Learning Content and Knowledge Management Convergence

The underlying issue behind the packaging of knowledge is the presentation of a key idea that will support the accomplishment of a metadata scheme. Our proposition developed after many implementations of e-learning projects in the ELTRUN research unit (http://www.eltrun.aueb.gr), is that the convergence of knowledge management and e-learning is realized through an integrated life cycle model. Each step in this model that is depicted in Figure 2 represents a value adding process. Each step sets a context for questioning about the required metadata that have to be attached to a generic knowledge source to formulate learning object. The first cycle summarizes a general knowledge management framework where six processes / activities (Relate / Value, Acquire, Organize, Enable Reuse, Transfer, Use) make possible the management of knowledge object (Figure 4). The second cycle stands due to the assumptions that learning requires a further adoption of general knowledge sources. The six processes of the second cycle in Figure 4 justify a learning oriented enrichment. The engagement of learners with the e-learning environment is becoming true through the employment of a number of learning processes.

The key proposition in our approach is that a number of metadata can support each step in the whole model as well as the learning processes as learning objects containers. For the specification of the elements of this metadata scheme a review of well-known metadata schema, has been undertaken and is presented in the following section.

Multidimensional Dynamic Learning Proposed Metadata Schema

Metadata are data about data (Weitlaner, 1999). In the context of learning, metadata are data about learning objects. This definition provides the major characteristic of metadata: they are descriptive indexing labels. However in the case of learning this is not enough. The indexing of a learning object seems to be a management facility with limited impact on the realization of engagement of learners. A lot of approaches concerning metadata have been proposed for general or specific learning purposes. Some of the most well known organizations that work in metadata specifications are the Aviation Industry Computer-Based-Training Committee (AICC), the IEEE Learning Technology Standards Committee, ARIADNE, the Educause Instructional Management Systems (IMS) Project, the World Wide Web Consortium (W3C), and the ADL. The need to specify metadata elements is translated to a two-fold requirement:

1. The specification of general metadata capable of supporting our theoretical proposition of a general Knowledge Management Framework; and
2. the determination of metadata focusing on learning processes

The critical review of several metadata schemas including IEEE Learning Objects Metadata, IMS, Dublin Core, SCORM, and GEM shows a rather superficial support for the second requirement although sufficiently supported is the first. The complexity of learning causes significant problems to the clarification of the practical dimension of what the achievement of different educational goals means. This gap in the propositions of the famous metadata schemas sets a context for significant contribution. Two key advantages of the presented metadata include:

1. Shifting the key justification idea from indexing categories directly related to distinct roles or properties (e.g. Author, Technical Characteristics, Pedagogy) to value delivering processes (Knowledge & Learning Processes).
2. Providing advanced capabilities for extension.

The distinction of different educational goals and learning functions that promote a goal-oriented delivery of content promotes a dynamic parameterization in an e-learning environment. The dual concern of the Shuell model, the fact that the specified learning functions can be used both by learners or educators influences and our approach: in an e-learning environment, the content is provided by authors and is exploited by learners; but the packaging mechanism of content has to based in metadata that promote the dynamic nature of learning content exploitation.

If we try to integrate the main ideas (see appendix A) that underlie the two approaches (Bloom & Krathwohl, 1984; Shuell, 1992), then we have to admit that there is a qualitative distinction of learning performance which is promoted through specific functions or processes that prerequisite different cognitive skills and promote different value to learners. From this perspective, the key issue of how to organize and package the learning content and how to engage learners in an e-learning environment can be derived through the establishment of dynamic learning processes. The combination of learning processes that have specific life cycles sets the context for learning scenarios.

The advantage of this approach is that if we specify metadata that support more than one learning process then this increases the exploitation capabilities of a learning object and promotes a personalized learning environment. In our model can be added more learning processes if we model them. The underlying logic is that the learning object is packaged through its adaptability to the context of specific learning processes (Figure 5).

The nine learning processes specified based on the work of Bloom and Krathwohl (1984) and Shuell (1992) are only some of the learning processes that can be modeled and used. New learning processes modeled require a number of new metadata schema elements.

The next step of metadata specification process is the definition in XML structures of every knowledge resource. Potentially each knowledge resource can be enriched using all the specified metadata elements. It can be also enriched for supporting several stages of the life cycle model of selected learning processes. This incremental approach where a general knowledge resource can be exploited through the attachment of metadata secures a dynamic e-learning environment.

In Figure 6, the hierarchy of our proposition concerning metadata elements is presented. A general knowledge resource can be enriched in three different ways, which potentially incorporate and differentiate learning value. In the two

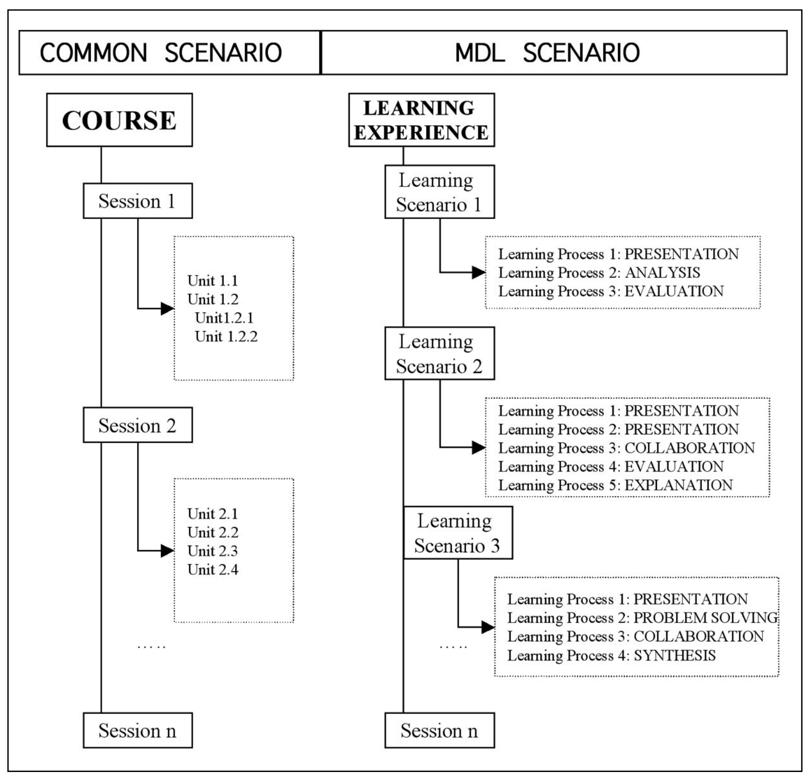

Figure 5. The proposed revision in e-learning content delivery method through value adding learning processes

first layers of enrichment the main emphasis is on the two life cycles that jointly formulate a descriptive model for knowledge management. The third layer establishes a dynamic way of value delivery. The specification of metadata for learning purposes indicates a dynamic way of content revelation and diffusion to learners. Specific learning processes can be chosen to formulate a learning scenario. The hierarchical way of content modules' organization gives its place to dynamic learning scenarios of integrated learning processes. The three layers of enrichment require effort from the side of content providers. The metadata elements cannot work in isolation of guidance and systematic work. The attachment of metadata especially for the purposes of the learning exploitation reveals the role of the teacher. Each piece of digital content is not a summary of a table, a text, nor a diagram which can be used for learning purposes. E-learning requires preparation and adoption. What you give is what you get in e-learning and from this point of view the management of a knowledge base in any e-learning system is of critical importance. The logic of our proposition is that a knowledge base of general management purposes is not the key issue. Learning is demanding in the sense that requires learners' active participation.

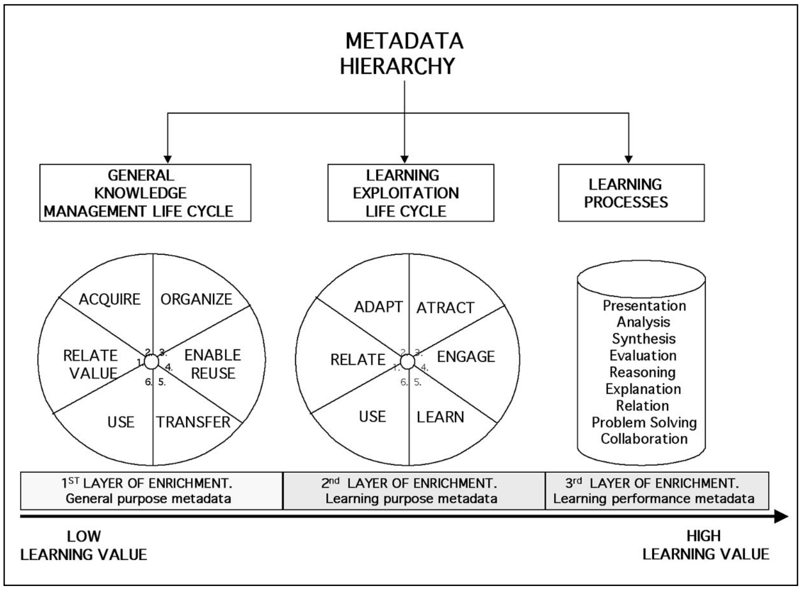

Figure 6. Metadata hierarchy

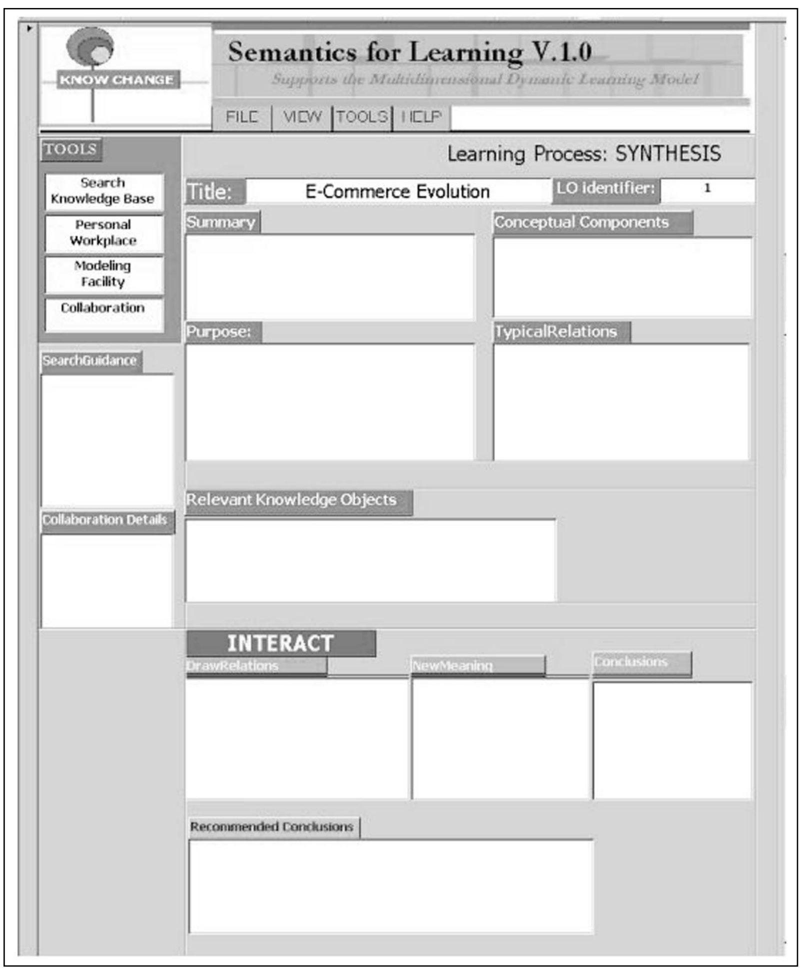

Figure 7. The case builder

In the next section, three tables present the proposed elements of the Multidimensional Dynamic Learning Metadata Schema. Table 2 summarizes the general metadata elements derived from a critical synthesis and evaluation of four established metadata approaches, while Table 3 provides an overview of metadata for learning purposes as proposed by several metadata schemas but grouped by the underlying logic of the second descriptive life cycle. Finally, Table 4 summarizes the metadata elements that support the defined learning processes.

The usage scenario, of these proposed metadata elements, includes the manipulation of general knowledge sources and the attachment of all the required metadata. It is easily understood that potentially a knowledge provider can provide the whole metadata set accompanying a resource. The learning process that will finally become the value driver and the mean for the diffusion of learning objects will specify the subset of metadata that will fill the layout of the specific learning process. This logic, the integration of the two basic knowledge management approaches justifies two interoperable systems: The Semantics for Learning™ and the Case Builder™, two applications that realize the detailed conceptual orientation of our approach. The case builder permits the dynamic customization of learning content to learners on a different basis than the traditional in e-learning. The basic idea is that we have to move our focus from learning modules to learning processes

Table 2. The MDL Metadata Schema Elements for General Knowledge Management Purposes

Metadata for general KM life cycle	
Relate/Value	Language, Subject, Quality, Main Concept
Acquire	Purpose, Title, Description, Creator, Publisher, Contributor, Identifier, Authors, and Institution
Organize	Date, Format, Location, Type, Source, Relation, Discipline, Sub discipline, Main concept, Main concept synonyms, other concepts, granularity
Transfer	Cost, Copyright & other restrictions, rights, Document type, Document handle, Document format, File size
Use	Operating system type, OS version, other platform requirements, Installation remarks, Access rights, restrictions, Usage remarks

Table 3. The MDL Metadata Schema Elements for Learning Exploitation

Metadata for learning exploitation	
Relate	Interactivity Type, Interactivity Level, Intended End user role, Learning context, Typical Age Range, Typical Learning Time, Language, Relation, Coverage, Audience, Grade, Pedagogy, End user type, Didactical context
Adapt	Metadata (author, creation date, last modified date, language, validator, validation date)
Attract	Semantic density, difficulty, Description, Standards, Quality, Duration, Difficulty Level, Interactivity Level
Engage	Essential Resources, Pedagogy, and Pedagogical Duration
Learn	Pedagogy teaching methods, pedagogy. Assessment, semantic density, annotation (annotator, creation date, content)

Table 4. The MDL Metadata Schema Elements for Learning Processes

Metadata for Learning Processes	
Presentation	Summary, Purpose, Essential Resources, Annotation, Topics, and Search Guidance
Analysis	Summary, Purpose, Conceptual Components, Typical Relations, Annotation, Relevant Topics, Search Guidance, Analysis conclusions, Collaboration Details
Synthesis	Summary, Purpose, Relevant Knowledge Objects, Typical Relations, Conceptual Components, Annotation, New Meaning, Draw Relations, Search Guidance, Recommended Conclusions, Conclusions, Collaboration Details, Guidance
Evaluation	Purpose, Relevant Knowledge Objects, Summary, Collaboration Details, Guided Theories, Guidance, Application Session, Simulation Session, Annotation, New Meaning, Conclusions, Recommended Conclusions
Reasoning	Summary, Purpose, Relevant Knowledge Objects, Annotation, New Meaning, Guidance, Conclusions, Recommended Conclusions, Starting Points, Collaboration Details
Explanation	Summary, Purpose, Relevant Knowledge Objects, Topics, Typical Relations, Draw Relations, Annotation, New Meaning, Guidance, Collaboration Details, Recommended Conclusions
Relation	Summary, Purpose, Relevant Knowledge Objects , Main Concepts, Draw Relations, New Meaning, Annotation, Guidance, Typical Relations, Conclusions, Collaboration Details
Problem Solving	Summary, Purpose, Relevant Knowledge Objects, Present Problem, Sub problems, Main Concepts , Collaboration Details, New Meaning, Annotation, Guidance, Conclusions
Collaboration	Summary, Purpose, Recording, Annotation, Findings

(Lytras & Pouloudi, 2001c) that jointly formulates a learning scenario. Figure 7, provides an overview of a screen shoot from the case builder.

The conceptual presentation of KM components for the realization of effective e-learning systems requires further explanation. The focus of the analysis would be the incorporation of dynamic futures that provide support for all the different roles within an e-learning system. Knowledge providers, case study developers, students, knowledge users, and authors are only a few of such roles. Depending on the user that we want to support through the KM e-learning system, we must develop subsequent conceptual models and deploy modeling processes to analyze the logic and the function of subsystem. Let us consider the majority of the various e-learning systems that dominate the market today. In most cases the authors (teachers) of such systems cannot support specific learning processes. The vast majority of such systems provide some evaluation tools, for example, quizzes, and a mechanism for content modules. Very few tools concentrate on the learning dimension of such systems. The deployment of information and communication technologies in the case of e-learning is limited to a few essential features. It appears that something has caused a shift of concentration from learning fundamentals to common things.

The use of any KM e-learning system has to establish mechanisms that promote the effectiveness of learning. Our approach for value establishment, exploitation and delivery through an e-learning system is based on the distinction of several learning processes with specific life

Table 5. Learning Process Life Cycles: Learners Perspective

	Presentation	Synthesis	Analysis	Evaluation	Reasoning	Problem Solving	Collaboration	Explanation	Relation
1	e.g. Present B2C e-commerce issues	e.g. How can we promote marketing through E-commerce	e.g. Analyze the issue of mobile commerce	e.g. Evaluate the proposed approach	Reason why Java is revolutionizing the EC applications development	e.g. Develop an electronic store	e.g. Team collaboration	e.g. Explain the Importance of E-commerce for business units	e.g. Relate networks and e-commerce
2	Provide summary	Define Objectives – State the Scope of The synthesis	Present Relevant Knowledge	Present in summary the tested situation	Present scope of reasoning/ Synopsis	Present Problem	Establish connection	State a thesis for explanations. Provide links or initial LO	Present generic learning objects
3	Allow detailed presentation	Find Relevant Learning products	Find Relevant Objects	Find relevant objects. Link theories and conceptual models	Find points of reasoning	Define and store sub problems	Allow structured collaboration	Search for relevant learning objects	Find Relevant Object
4	Link relevant objects	Present Learning Products through templates	Discover Components	Establish collaboration sessions	Draw logical arguments for each point	Analyze concepts	Record conversations	Summarize relevant objects in template	Analyze and summarize Objects
5	Provide suggestions for further exploitation	Summarize key contributions	Define Connections – Relations	Allow application / simulation if possible	Summing up	Synthesize approaches	Organize answers	Present object	Synthesize and store findings
6	Allow personal notes	Integrate meaning	Draw conclusions	Create new meaning	Store arguments in personal workspace	Collaborate with others	Store Findings	Analyze	Draw conclusions/ state relations
7	Update personal workspace	Develop new Learning Products	Store conclusions	Store new findings		Develop knowledge objects		Draw conclusions	Create new meaning
8		Store new Findings				Store findings		Summarize synopsis	

cycles (see Tables 5, 6). The research assumption is that each learning process has a potential different learning value and the realization of each one in a KM e-learning environment requires a tremendous effort. This distinction has further impact on the development of the KM toolset. Each process has to be analyzed in detail and to be modeled using a modeling language such as UML. This modeling approach provides the logical specification of each learning process in a manner easily exploited by information technologies and specific programming languages. Moreover, the life cycle for the realization of each process has to be distinguished when we refer to knowledge providers or knowledge users. Finally, we have to mention that the life cycle of

Table 6. Learning Process Life Cycles: Authors/Knowledge Providers

Presentation	Synthesis	Analysis	Evaluation	Reasoning	Problem Solving	Collaboration	Explanation	Relation
e.g.: Knowledge source/learning object: a PowerPoint presentation concerning Types of E-commerce	e.g. How can we promote marketing through E-commerce	e.g. Analyze the issue of mobile commerce	e.g. Evaluate the proposed approach	e.g. Reason why Java is revolutionizing the EC applications development.	e.g Develop an electronic store	e.g. Team collaboration	e.g. Explain the Importance of E-commerce for business units	e.g Relate networks and E-commerce
Provide the Learning Object Provide the summary of the learning product	Provide in synopsis and in detail the scope of synthesis	Provide Relevant Knowledge, Link relevant objects	Provide a summary for the tested situation	Provide scope of reasoning/ Synopsis	Provide Problem Description (link relevant objects)	Determine availability (off/on line tools)	Provide a thesis for explanations. Provide links for initial LO	Provide generic learning objects
Specify the details for the current object	Provide Relevant Learning Objects (papers, articles, extracts)	Provide metadata	Depict relevant theories and conceptual models	Customize learners help	Provide notes for sub problems	Define modes for structured collaboration	Provide links of relevant objects from knowledge base	Find Relevant object
Provide/choose relevant knowledge objects from knowledge pool.	Choose Learning Templates	Provide recommended parts of analysis	Provide suggestions that would facilitate learning	Provide a few logical arguments for each point	Customize learners help Provide key concepts	Determine Recording of conversations	Summarize metadata concerning synopsis of LO	Customize learners help
Provide suggestions for further exploitation	Select Support tools (collaboration, search)	Provide suggested Connections – Relations	Customize learners help	Provide suggested Summing up	Suggest approaches. Hints for knowledge exploitation	Allow answers management (link to Knowledge Base)	Choose Presentation Templates	Provide key issues
Provide questions/ assignments concerning specific item	Allow posting of findings	Provide conclusions	Allow posting of findings	Allow posting of findings	Determine providers collaboration availability		Suggest synopsis of analysis	Provide suggested conclusions-state relations
	Customize learners help						Provide suggested conclusions	Allow posting of findings
	Allow posting of findings						Customize learners help	

each process does not imply a sequential rotation of relevant tasks but rather a number of interconnected and integrated tasks.

The analysis of the value processes defines a parameterization for any e-learning system. Of course the scope of the implementation of such a system broadens its functionality. In general an e-learning system with KM functionalities can support academic institutions, business organizations, life long learning institutes, social organizations, training departments, and so forth. In most cases the learning content focuses either on a subject or on a business process. The full utilization of such a system and its value contribution has to take into account the parameter of integration. In business environments this integration could imply the interconnection to vital enterprise applications that perform the business processes.

CONCLUSIONS

The overall approach described in this article provides a context for exploitation focusing on learning. The incremental refinement of conceptualization leads to a set of metadata that can assist the transformation of knowledge resources to reusable learning objects. This step-by-step justification finally drives an extensive XML specification of the metadata schema. The selection of learning processes as the carrier of value expands the dynamic nature of an e-learning system. The whole approach appeared to integrate the two well-defined and distinct approaches to knowledge management, the knowledge artifact and the knowledge activities approaches. Our future research agenda concentrates on the analysis and the development of a dynamic e-learning environment based on the key ideas of the Knowledge Interchange Concept. Version 1.0 of the *Semantics for Learning*™, which is a prototype that requires further empowerment, has been completed. The next steps concern the development and promotion of the integrated Multidimensional Dynamic E-learning environment. We envisage that its focus on learning processes will promote further the research in e-learning and the performance of e-learning.

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APPENDIX

MDL Learning Processes

		Presentation	Synthesis	Analysis	Evaluation	Reasoning	Problem Solving	Collaboration	Explanation	Relation
T. Shuell Learning Functions	Expectations	G	G	G	G	G	G	G	G	G
	Motivation	S	S	S	S	S	S	S	S	S
	Prior knowledge activation	L	L	L	L	L	L	L	L	L
	Attention	L	L	L	L	L	L	L	L	L
	Encoding	G	G	G	G	G	G	G	G	G
	Comparison		S	S	S	S	S		S	S
	Hypothesis Generation		S	S	S	S	S	S	S	S
	Repetition	L	L	L	L	L	L	L	L	L
	Feedback	S	S	S	S	S	S	S	S	S
	Evaluation	L	S	S	S	S	S	S	S	S
	Monitoring	L	S L	S L	S L	S L	S L	S L	S L	S L
	Combination, Integration, Synthesis		S	S	S	S	S		S	S
Bloom's Taxonomy	Knowledge	G	G	G	G	G	G		G	G
	Comprehension	L	S L	S L	S L	S L	S L		S L	S L
	Application			S	S	S	S			S
	Analysis			P S	P S	P S	P S	S	P S	P
	Synthesis		P S	P S	P S	P S	P S	S	P S	P
	Evaluation		P S	P S	P S	P S	P S		P S	P S

P: Learning Process is influenced by / can support S: Metadata Specific in Each Process

G: Metadata of General Purpose L: Learning Scenario