

# Educational Models and Interaction Patterns for Instruction

## An example of LOM Categorization

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### **Abstract:**

*Based on the didactical scenario approach by Baumgartner/Bergner we explore over 50 educational interaction patterns, which are the components of every learning scenario. In contrast to the traditional literature, which is mostly lacking in granularity, we think that schools as well as other institutions of education need a more detailed description. The aim is to break down educational scenarios into smaller units (interaction patterns) that can be handled by teachers. Following this approach they can plan their classes and choose the adequate technical tools for the virtual learning experience.*

*For teachers' and trainers' convenience these 50 interaction patterns are presented on a website using the CMS Frontier/Manila. The data are categorized in conformance with the recommendation of the IEEE 1484.12.1-2002 Learning Object Metadata standard. The paper discusses and describes this implementation.*

## **1 LOM: What is it and why do we need it?**

LOM stands for Learning Object Metadata. "Metadata is information about an object, be it physical or digital" [1]. It is data on a higher level, data about data of the learning object, therefore metadata.

To understand the importance and use of LOM we first have to cover why we need standards at all. The main idea behind standards in e-learning is to provide open and interoperable systems. This is the only way to guarantee that content from one platform can be transferred and re-used on another platform. In detail we can distinguish between five different goals of standards:

1. Interoperability: Does the system work with other systems?
2. Re-usability: Is the content (the "learning object") re-usable in other circumstances?
3. Manageability: Are there (understandable and reusable) records and reports about the learner's behavior, structure and relationship of the learning objects?
4. Accessibility: Are learners able to access the content they are looking for at any convenient time?

5. Durability: Is it guaranteed that the system with all the learning objects still does work after technology has changed?

As the number of learning objects has grown exponentially and our needs for learning expand equally dramatically, there is an increasing lack of information of metadata about objects. These standards aim at addressing this problem by defining a structure for interoperable description of learning objects [2].

LOM groups the characteristics in general, life cycle, meta-metadata, educational, technical, educational, rights, relation, annotations and classification categories. The following is an excerpt from a paper by Eric Duval [3]:

There are 9 categories that regroup characteristics of learning objects:

1. The *general* category groups the general information that describes the learning object as a whole. This category includes elements that indicate an identifier for the learning object, its title, the human language it uses to communicate to the end user, a textual description, keywords, etc.
2. The *Lifecycle* category groups the features related to the history and current state of this learning object. It includes information on the status and version of the learning object, as well as all on contributions of both individuals and organizations, including the role these entities played in the contribution.
3. The *Meta-Metadata* category groups information about the descriptive metadata itself (rather than the learning object that the metadata instance describes). This category mirrors the lifecycle one, in the context of the metadata, so that for instance the origin of the description, as well as its potential validator, etc. can be identified.
4. The *Technical* category groups the technical requirements and technical characteristics of the learning object. This includes data elements that cover its format, size, location, as well as technical requirements for using the learning object.
5. The *Educational* category groups the educational and pedagogic characteristics of the learning object. These data elements indicate
  - a. The interactivity type, i.e. whether the learning object is more suited for active or expositive learning;
  - b. The resource type, like for instance exercise, simulation, questionnaire, etc.
  - c. The interactivity level (on a scale from very low to very high);
  - d. The semantic density (idem);
  - e. The intended end user role (teacher, author, learner or manager);
  - f. The context (school, higher education, training or other);
  - g. The typical age range;
  - h. The difficulty level (again on a scale from very low to very high);
  - i. A description of how the learning object is to be used in education or training;
  - j. The language of the intended end user (which may be different from the language of the learning object itself, for instance in the context of language learning);
6. The *Rights* category groups the intellectual property rights and conditions of use for the learning object. This includes information on whether or not any cost is involved with the use of the learning object, and whether or not any copyright restrictions apply.
7. The *Relation* category groups features that define the relationship between the learning object and other related learning objects. This category includes information on the nature of the relationship (“is based on”, “is part of”, etc.).

8. The *Annotation* category provides comments on the educational use of the learning object and provides information on when and by whom the comments were created.
9. The *Classification* category describes this learning object in relation to a particular classification scheme. The Classification category may be used to provide certain types of extensions to LOM Schema, as any classification system can be referenced.

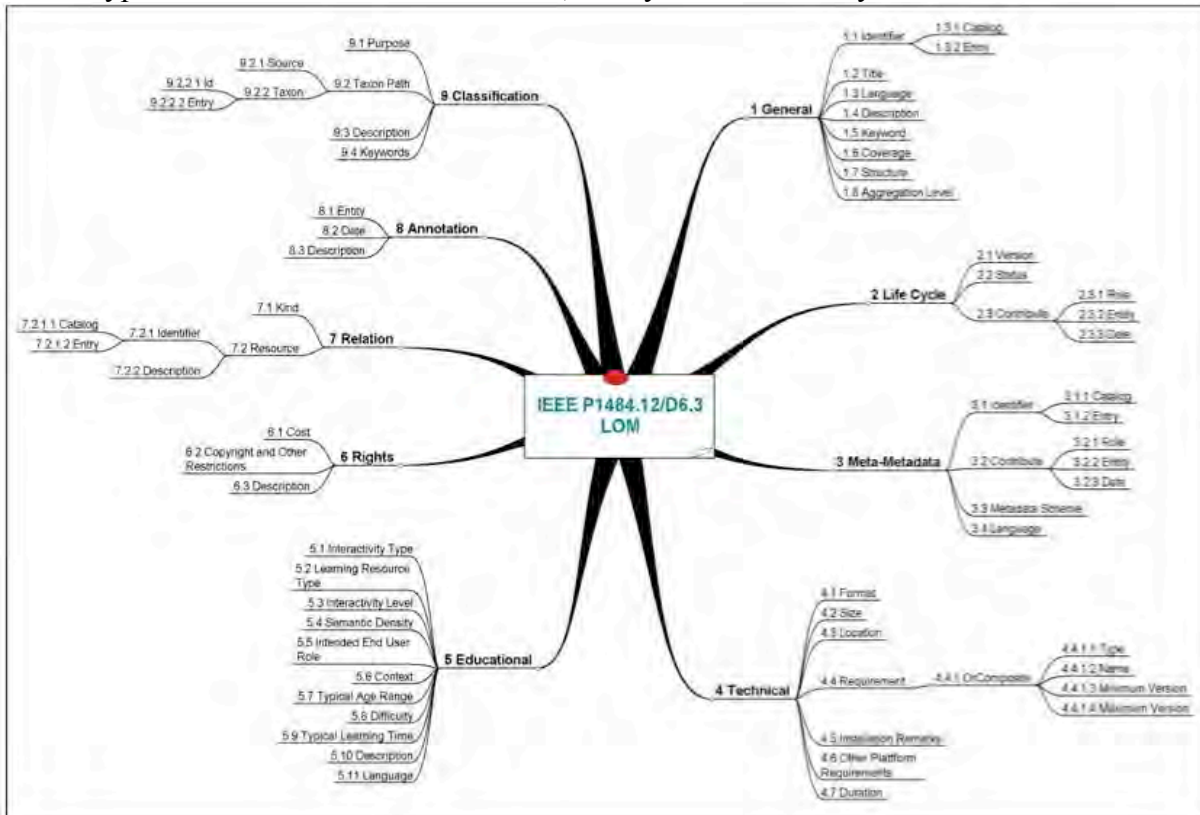


Fig. 1: Mindmap of LOM categorization scheme by Thomas Herrmann, from [3] p.7 quoted

For a conceptual understanding one can imagine the 9 categories as branches with leaves (the actual database entries) demonstrated by the following graph:

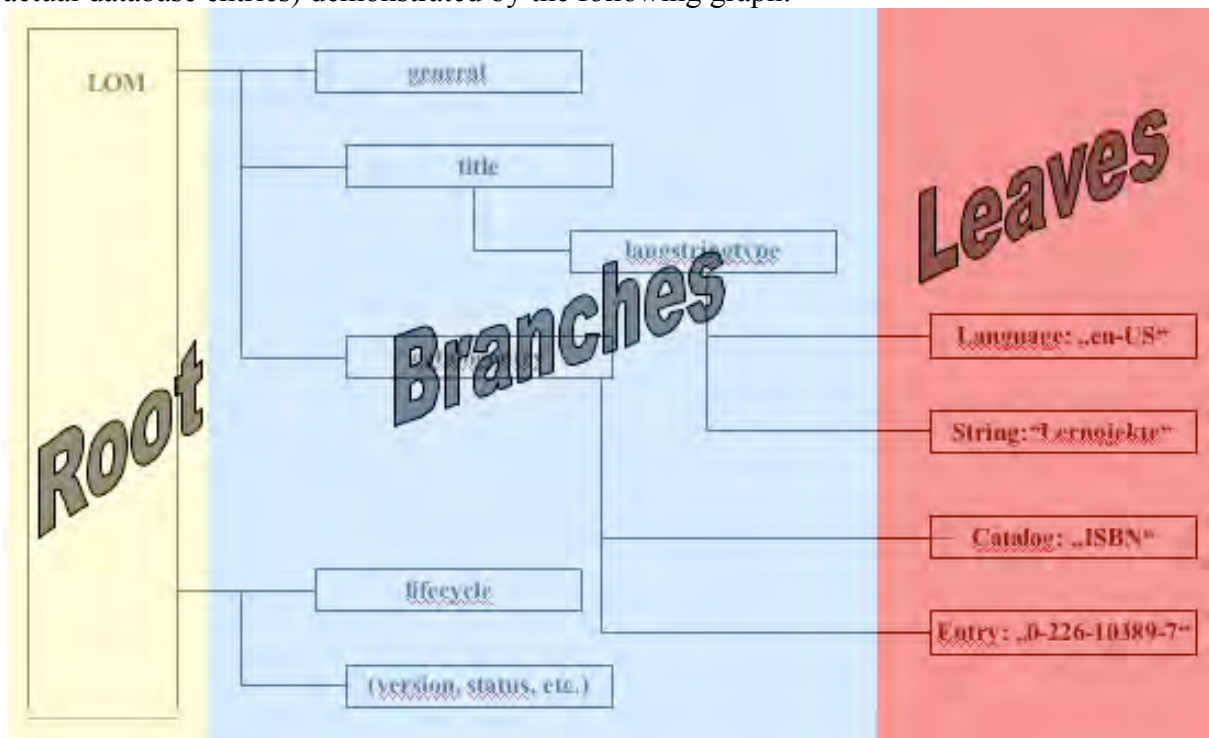


Fig.2: Tree-structure model of LOM categorization

Collectively, these categories form the LOMv1.0 Base Schema. For each of the data elements, LOM defines ([3], p.9):

- The name: the name by which the data element is referenced;
- Explanation: the definition of the data element;
- Size: the number of values allowed;
- Order: whether the order of the values is significant (only applicable for data elements with list values);
- Example: an illustrative example;
- Value space: the set of allowed values for the data element – typically in the form of a vocabulary or a reference to another standard;
- Datatype: indicates whether the values are:
  - LangString (a string value in different languages),
  - DateTime (a moment in time),
  - Duration (a length of time),
  - Vocabulary (an extensible set of suggested appropriate values),
  - CharacterString (simple string value), or
  - Undefined

The Draft for the Learning Object Metadata specification has been approved by the IEEE Review Committee on June 12, 2002 and is now a draft of a proposed IEEE-SA Standard 1484.12.1.

## **2 Some critical considerations on LOM standard**

The purpose of LOM is to facilitate search, evaluation, acquisition, and the use of learning objects for learners, instructors or automated software processes. At the moment LOM is the most advanced area in terms of standardization of learning technology. But even so, it has – at least from the educational perspective – several severe weaknesses. Most can be found in the educational category. These items should provide “the pedagogical information to those involved in achieving a quality of learning experience” [4] (teachers, managers, authors and learners).

We cannot go into a thorough and complete discussion of all problems with the LOM standard. In the following are two representative examples of a conceptual mismatch in the design of LOM standard:

### **2.1 Learning resource type**

It describes the specific kind of learning object. You can provide an ordered list of values, maximum are ten items, the first as the most dominant one. The problem with this category can be found in the pre-described values (the vocabulary) that should be used: exercise, simulation, questionnaire, diagram, figure, graph, index, slide, table, narrative text, exam, experiment, problem statement, self assessment, lecture.

This vocabulary mixes different media types (e.g. text, slide) with different representation of content (e.g. graph, table, narrative text) and different educational interaction pattern (e.g. simulation, experiment, lecture). Neither are these subcategories complete (e.g. there is no media type of sound, movie) nor are the semantic borders between different vocabulary well defined (e.g. what is the difference between a diagram, a figure or a graph?).

## **2.2 Interactivity level**

Learning objects should be characterized by their degree of interactivity. Interactivity in this respect means the level to which the learner can influence the aspect or behavior of the learning object.

There are 5 levels specified: very low, low, medium, high, very high. But what do these levels mean exactly? There is no operationalization to be found anywhere in the LOM specification. The only qualification made so far states that the interactivity level has to be seen in relation with the interactivity type (active, expositive and mixed), another educational subcategory. The interactivity level has to be evaluated within the more general interactivity type subcategory. If for instance the expositive (passive) learning mode predominates the learning object - but the document is a sophisticated hypertext - then the interactivity level has to be judged under these general circumstances as “very high”. On the other hand if a simulation (e.g. predominant active learning mode) does just have one control which has to be set only once during the process the interactivity level has to be judged as “very low” – even if it is still much higher and complicated than in the hypertext example.

This very loose definition makes it almost impossible to set comparable standards. Even worse: Another obscure note points out that there is no general standard intended: “Inherently, this scale [of interactivity levels] is meaningful within the context of a community of practice.” [5]. With this note the whole enterprise of standardization is transferred to “communities of practice”. Apart from a definition what kind of “communities of practice” are meant (professional ones like math, language teachers, methodologies ones like cognitivists, constructivists, learner age cohorts etc.) the question may be asked: Why bother with a standard at all if anybody can define his/her own scale?

## **3 Implementation of LOM standard**

### **3.1 General remarks and observations**

Our learning objects consist of the description of educational interaction patterns as described in the companion article by Baumgartner/Bergner 2003 [6]. At the first perception there seems to be a difficulty in the usage of LOM as it seems that our data are oriented towards teachers (and not towards pupils or students). But this is a misconception: Our data are directed to teachers as a professional community, we strive to teach teachers. It is a kind of program for further education for teachers.

The starting point was a project report for PlaNet ET (Platform and Network for Education Technology) [7] sponsored by the Austrian Ministry of Education, Science and Arts (BM:BWK) [8]. The result can be seen at our website [9]. For the implementation process we went through the following procedure:

1. In a first step we revised our data thoroughly and restructured them in a way to have the best possible fit with the LOM standard.
2. From the LOM dataset we took a subset and adapted it for our needs. This is allowed as LOM specifies a base schema, which may be extended as practice develops. But one has to observe the following rules:

- a. Extension shall retain the value space and datatype of the data elements from the LOMv1.0 Base schema.
  - b. Extensions shall not define data types or values spaces for aggregate data elements in the LOMv1.0 Base Schema.
  - c. In order to maximize semantic interoperability, *extended* data elements should not replace data elements in the LOM structure. An organization for instance should not introduce a new data element “name” that would replace the LOM 1.2:General.Title element.
  - d. In order to maximize semantic operability, users should carefully map their metadata to the data elements of the LOM standard. The user for instance should not map an element to describe fonts used in the document to the data element 1.2:General.Title.
  - e. Vocabulary – recommended list of appropriate values – is defined for some data elements. Other values, not present in the list, may be used as well. However, metadata that rely on the recommended values will have the highest degree of semantic interoperability, i.e. the likelihood that such metadata will be understood by other end users or systems is highest.
  - f. The meaning is associated with vocabulary defined by the corresponding term in the Oxford English Dictionary, 2<sup>nd</sup> Ed., 1989, unless explicitly defined in the LOMv1.0 Base Schema itself.
3. Then we defined and designed the database structure and the necessary entry forms. As we have decided to implement our data with the Content Management System Frontier/Manila [10,11,12] we used for this task the plugin “AddedValues” [13]. This Manila enhancement, designed by David Bayly [14] is still under construction and in its beta state (currently 1.0b168). This led to the disadvantage that there was not much experience with this new tool to draw upon and big parts of the documentation are still missing. On the other hand we had the unique possibility to discuss our problems with the developer himself and to get some special features we needed to be programmed by courtesy.

Edit Story

http://planetet.c3-initiative.info/addedValuesPI/discuss/edit/editInBrowser\$179

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## Edit Story

### ENTRY FORM FOR ENGLISH DATA INPUT

**Subject:**

**Text:**

Invite students for a chat. Announce that taking turns in conversation will be used in some parts of the chat.

In the following you may read an example of sentences formulated in advance for a "free chat" using taking turns method:

<blockquote>  
 Let's first deal with [i]free chat [i]. Then we'll start with [i] taking turns in conversation [i] . I'll give the alphabetical order.

### METADATA

**Title:**

URL ID	Mode	Tool	Groupsize	Duration
<input type="text" value="04"/>	<input type="text" value="Synchronous"/>	<input type="text" value="Chat"/>	<input type="text" value="5-7"/>	<input type="text" value="60 min."/>

**Description:**

**Objective:**

**When to use:**

<ul><li>"Free chat" threatened by chaos.</li><li>Some students dominate discussion while others are passive.</li></ul>

**Annotation:**

Fig.3: LOM Entry form

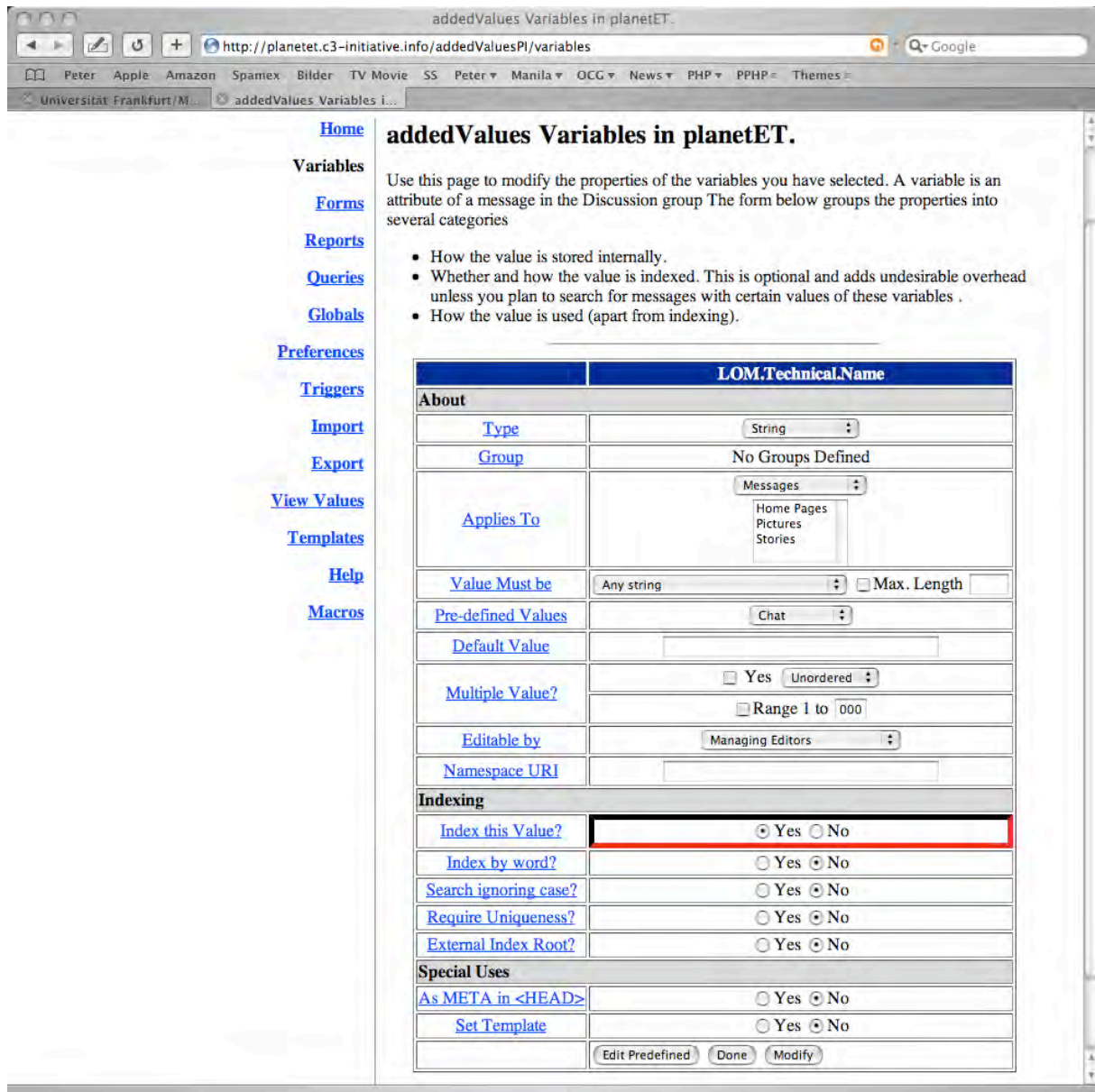


Fig.4: Defining the structure of the database Manila with AddedValues

### 3.2 Details of LOM implementation

The following table (cf. annex) presents a detailed overview on the details of our LOM implementation. As aggregates (branches) do not have value spaces we restrict the table to the data elements (leaves) of the tree structure.

#### References:

- [1] IEEE, Standards Department (2002). "Draft Standard for Learning Object Metadata." [http://ltsc.ieee.org/doc/wg12/LOM\\_1484\\_12\\_1\\_v1\\_Final\\_Draft.pdf](http://ltsc.ieee.org/doc/wg12/LOM_1484_12_1_v1_Final_Draft.pdf) (166 kB, 23.08.03)
- [2] IEEE, p.ii
- [3] Duval, Eric (2002). Technology Standardization: Too many? Too few? Reader Neue Medien Tagung. Frankfurt/M., Johann Wolfgang Goethe-Universität Frankfurt: 5-13. [http://www.rz.uni-frankfurt.de/neue\\_medien/standardisierung/reader\\_gesamt.pdf](http://www.rz.uni-frankfurt.de/neue_medien/standardisierung/reader_gesamt.pdf) (4,6 MB, 23.08.03)



- [4] IEEE, p.23
- [5] IEEE, p.25
- [6] Baumgartner Peter, Ingrid Bergner (forthcoming): Ontological stratification of virtual learning activities – Developing a new categorization scheme.
- [7] Maier-Häfele Kornelia and Häfele Hartmut (2003): Praxis-Handbuch für Online-Lehrende. Technical report, not published.
- [8] <http://www.planet-et.at/>
- [9] <http://planetET.c3-initiative.info/>
- [10] <http://frontier.userland.com/>
- [11] <http://manila.userland.com/>
- [12] Gstrein Silvia and Jersabek Andrea (forthcoming): E-Learning with Content Management Systems in Schools – Demonstrated with Sites in Manila.
- [13] <http://www.addedvalues.org/>
- [14] <http://www.baylys.com:8080/>. Special thanks to David A. Bayly for supporting the c3I project (<http://www.c3-initiative.info/>) and developing addedValues as a convenient means for organizing Manila websites, entering and searching of metadata.

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Nr.	LOM Name	our Name	Entry Form	Value space	Explanation
1.1.2	General.Identifier.Entry	LOM.General.Identifier.Entry	URL ID	01 02 03 ...	The real ID is constructed from the hierarchy of the website pages. It uses an automatic („trigger“)script and looks for different variables in the following order: 1.3:LOM.General.Language the pre-defined report form 4.4.1.2:LOM.Technical.Name 1.1.2:LOM.General.Identifier.Entry Result for instance is: DE/full/Chat/05
1.2	General.Title	LOM.General.Title	Subject		Name given to this learning object. In our implementation the name within quotes is also a hypertext link to the LO itself. This provides an easy way of references in the interlinked information structure.
1.3	General.Language	LOM.General.Language	Language	DE EN	Our website is designed as a multilingual website. The user can choose in which available language he wants to be presented the LO's. There is also the feature of an automatic detection from the calling IP address. (This feature is not fully implanted yet.)
1.4	General.Description	LOM.General.Description	Description		A textual description of the content of the LO
4.4.1.1	Technical.Requirement.OrComposite.Type	LOM.Technical.Name	Mode	synchronous asynchronous mixed	Normally the technology required to use this LO. All our data need browsers but are hardware independent (“Educational interaction pattern” do not force specific hardware.)

4.4.1.2	Technical.Requirement.OrComposite.Name	LOM.Technical.Name	Tool	Chat Whiteboard Forum Email Diverse	Normally used for operating system and type (brand name) of browsers or the other tools. We have adapted it to the general tool category <sup>1</sup> .
5.9	Educational.TypicalLearningTime	LOM.Educational.TypicalLearningTime	Duration	5 min. 10-15 min. 30-45 min. 60 min. 90 min. 1-2 days 3-5 days 7 days Weeks Term Variable	Approximate time it takes to work with or through this learning object for the typical intended target audience. In our case the vocabulary refers not to our primary target group (the teacher as student) but to the educational implementation of the LO and therefore to the future learner who is confronted with the application of our LO.
5.10	Educational.Description	LOM.Educational.Description	Text		Description on how the LO is to be used. As our data are directed towards teachers this is the essential and main part of our LO.
7.2.1.1	Relation.Resource.Identifier.Catalog	LOM.Relation.Catalog	Reference	URI ISBN	not fully implemented yet
7.2.1.2	Relation.Resource.Identifier.Entry	LOM.Relation.Entry	Relation		not fully implemented yet
7.2.2	Relation.Resource.Description	LOM.Relation.Description	Description		not fully implemented yet
8.3	Annotation.Description	LOM.Annotation.Description	Annotation		This category provides comments on the educational use of these LO's and information when and by whom the comments were created. This category enables educators to share their

<sup>1</sup> The usage of the technical.requirement.orComposite metadata may a little bit problematic in our case. To indicate that we did not use the official name of requirement.OrComposite.

					assessments of learning objects, suggestions for use etc.. It is planned to combine this feature with the discussion forum on the website. At the moment all annotations are from the authors of the LOM's.
		my.LOM. General.Context	Usage		We did not find a corresponding data entry for this kind of information. As we thought that it would be important information for educators, we added our own category.
		my.LOM. General.Context. Category	when to use	Prologue Starter Work through Presentation Problemsolving Reflection Quizzes Variable	
		my.LOM. General.Groupsize	Groupsize	1 1-2 2+ 3+ 3-5 5-7 7 max 7-10 10+ 15 max Variable	
		my.LOM. General.Purpose	Objectives		