

## METADATA IN E-LEARNING SYSTEMS: FOCUS ON ITS VALUE FOR THE USER

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It is widely agreed upon that 'good' metadata are a key factor for efficient use of e-learning systems. Generally, two fundamentally different types of metadata exist: Metadata generated by the system when content is created or added, and metadata generated by humans for humans. The latter takes one of two forms: (I) A number of fields in a form that have to be filled in by the creator of a piece of learning content; and (II) A list of pre-defined, standardised descriptors from which the applying ones have to be selected (ontology). Either approach aims at overcoming potentially differing valuations of metadata descriptors due to individual interpretations. Both approaches heavily depend on the e-learning application's underlying knowledge domain, and are often driven by the requirements imposed by the services defined for the data repository in use.

E-learning systems per definition incorporate at least two roles: the teacher's and the student's. The teacher produces and codifies, students and other teachers search and retrieve learning content. Each of these tasks relies eventually on a set of metadata descriptors. As a consequence, a considerable number of efforts have been undertaken in order to improve metadata applications for e-learning systems. Unfortunately however, most of these efforts have been directed towards more automated systems, that devalue the teacher and student by assigning them merely the roles of information source and sink. We think that it has been overseen, that it is eventually the teachers and their students that need to work with and hence access resources within an e-learning system.

The crucial question is: What are the relevant metadata descriptors in order to suitably support the users' - the teacher's and student's - work with an e-learning system and the information contained therein? In this paper we hence first list fundamental requirements to be met by metadata descriptors to suit the users well. We subsequently also propose a set of 22 descriptors that, as a whole, meet these requirements and are therefore intended for a user-friendly pragmatical application in e-learning systems.

### 1 Introduction

Metadata is data about data. 'Good' metadata therefore, is a small set of descriptors that allows handily and efficiently to describe, locate, work with and also classify other, more extensive information sources. Metadata however, is only useful when information producers use the same set of descriptors, which makes readily apparent why heavy standardisation efforts have been undertaken with respect to e.g. the World Wide Web [13] and e-commerce [7].

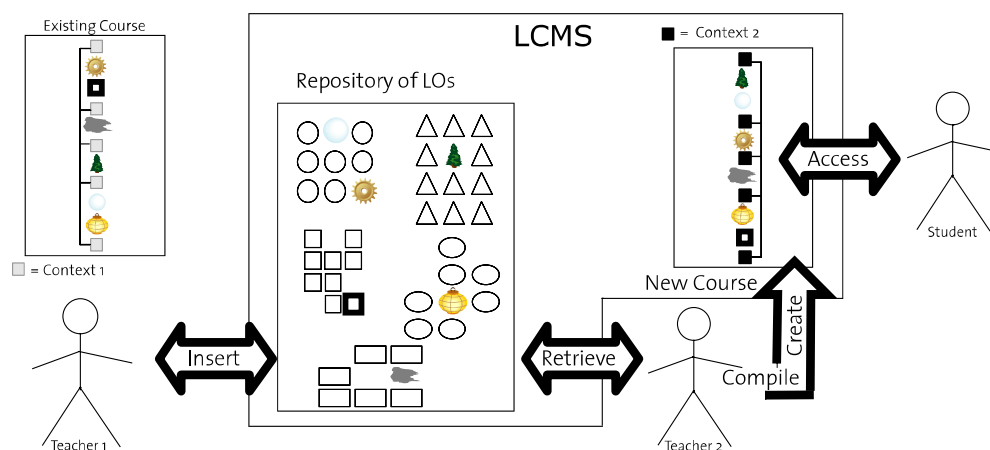
Only more recently, metadata standardisation efforts have also been extended to the instructional domain. In this context, metadata are tailored towards describing units called *Learning Objects* (LO) [8]. There exist a variety of metadata initiatives in the domain (e.g. LOM [11], ARIADNE [1]), whose common goal it is to cater for the technical requirements in the e-learning domain that arise through the pursuit of durability, interoperability, accessibility and re-usability of LOs.

At two points in the process of creation and re-use of e-learning material, metadata descriptors play a key-role for the *human* user of e-learning systems (Figure 1): (I) When material is produced and codified by teachers (e.g. in order to publish it in a Learning Content Management System (LCMS) [14]); and (II) when learning content is searched, accessed or retrieved for an intended re-use either by teachers or students. Up to the present however, the ultimate goal for standardisation efforts has been to facilitate *automatic* extraction of metadata descriptor content for new e-learning material, implicitly devaluing the teachers and students by assigning them merely the roles of information sources and sinks. We think that it has been fatally overseen that, after all, *the teachers and their students* need to work with an e-learning system and hence access the resources within.

Existing specifications have so far difficulties to fulfil their expectations due to one main reason: They never proposed a Pedagogical Model for e-learning systems to enable the didactical issues to be discussed in direct connection and on a same level with system architecture (Architectural Model) or technical requirements for metadata (Information Model) [9]. As a consequence, the specifications do only inadequately support the representation of learning content or its context, and are furthermore not a fast, handy, reliable and understandable way for teachers to communicate value and characteristics of available material to others in the e-learning community.

What is hence needed, is a set of *user-friendly* standardised, domain independent, metadata fields to fill the gap, i.e. metadata that is *tailored towards the needs of teachers and students* and the work they try to achieve when working with an e-learning system. In this paper, we will therefore tackle two main questions in this respect: (1) What are the requirements that have to be met by such user-friendly metadata for e-learning systems? (2) What would be a first basic set of metadata fields that fulfil the previously defined requirements?

The remaining of this paper is organised as follows: Section 2 presents the user-sided requirements identified. Section 3 lists and defines a set of 22 metadata fields which after extensive literature study were considered to be fundamental in order to meet the user-side requirements for metadata of Section 2. And finally, Section 4 discusses and concludes on the results presented in this paper, and points out research questions to be addressed in the future.



**Figure 1:** Publication and reuse *process* supported by metadata for learning material, considering as example a Learning Content Management System (LCMS) (after [14]): The existing course is decomposed by Teacher1 into Learning Objects (LOs), and its context removed for *insertion* into the system's repository. Later, Teacher2 *retrieves* the LOs and *composes* a new course by adding her specific context. Finally, a student *accesses* the newly created course and re-uses it for her own aim.

## 2 Requirements for user-friendly e-learning metadata

What are the requirements to be met by user-friendly metadata for e-learning systems? In order to answer this question, the following list was compiled based on works from a variety of domains which in several ways work with metadata: Didactics and Pedagogy (e.g. [9]), E-learning Applications (e.g. [6]), Library and Information Sciences (e.g. [3]) and Personal Information Management Systems (PIMS, e.g. [10, 12]).

1. *Pedagogical and didactical accuracy:* Learning material is always produced for a target audience and with a certain aim and method in mind. This is naturally also the case for material produced in the e-learning context. As a consequence, target audience, instructional goals and methods must be characterised as precisely as possible. Only then the material is ready for re-use, which may also include adaptation to new target audiences or to a different method, for instance.
2. *Knowledge domain accuracy:* The instructional material treats a certain subject within a specialised domain. Therefore, this also requires a detailed description of the topics within the knowledge domain that are treated in the material, independently of the didactical context.
3. *Process independence:* The descriptors need to be equally supportive for both, the process of accessing existing material for an indented re-use, and the act of describing new material for insertion into the system.
4. *Granularity independence:* Granularity relates to the amount and extent of material compiled to and treated in a single entity. This may be a course, a lesson or just a learning object. Granularity therefore,

is a descriptor on its own right. It must, however, *not* affect the set of descriptors as a whole, but only the *content* of the remaining descriptors in the set.

5. *Clear, intuitive definitions:* Each individual descriptor has to be comprehensive *and* well understandable by teachers and students alike. The definition therefore requires to be short and accurate, 'non-artificial' for persons without a technical background. Only if these requirements are already met, the use of carefully designed and by the target audience again well understandable ontologies (i.e. lists of pre-defined values to select from), may be used to support correct application
6. *Few in number:* Descriptors are habitually only filled in accurately, when the effort is limited and can be completed efficiently and concisely at the same time. Hence, the fewer required fields there are, the better.
7. *No extra effort required for descriptor content assignment:* When teaching material is created, a number of circumstances are always known, e.g. target audience, topic, method employed etc. When, after creation, the material is finally inserted into the LCMS, the act of filling content into descriptor fields should not require additional effort at this stage of the production process. To ease even the remaining burden, ontologies shall be used wherever applicable.

### 3 User-friendly e-learning metadata fields: A proposition

This chapter presents the results of our quest for user-friendly, *application oriented*, e-learning metadata, namely a set of 22 descriptor fields, that as a whole, fulfil the requirements listed in the previous section. The upcoming lists were compiled based on existing metadata standards [1, 11, 13] as well as research in Personal Information Management Systems (PIMS) [12], Library and Information Sciences [3] and Didactics [2, 5].

**Table 1:** User-friendly metadata of a purely pedagogical / didactical type

Field Name	Definition	Source
1. Subject / Course	Discipline and specific domain the material is intended for.	[1] [2] [11] [13]
2. Topic	<i>Perceived</i> content of the document through singular words that have been grabbed while skimming the document.	[2] [11]
3. Level	Educational level the material is intended for. E.g.: Primary School, High School, College, University	[1] [2] [11]
4. Student Target Age	State the estimated age of the intended target student audience E.g.: 7-8 yrs, 14-16 yrs, 19-23 yrs, > 22 yrs.	[1] [2] [11]
5. Learning Time	Estimated time the students need to work through the material. This indication can be based a) on the judgement of an expert or b) on experiences of users.	[1] [11]
6. General Prerequisites	General knowledge of other disciplines, required as basis to benefit optimally from the material.	[2]
7. Specific Prerequisites	Knowledge within the specific domain, required as basis to benefit optimally from the material.	[2]
8. Media/presentation aids required	States the additional means required to support the act of learning. E.g.: Paper & pencil, Real Player, tape recorder	[2]
9. Method	Defines the course of instruction (~30 min. to 10 hrs.) E.g.: Case study, group work, mastery learning.	[2]
10. Technique	Technique refers to the presentation concept within a specific instructional method. E.g.: Advanced Organiser, Rule-Example-Rule.	[2]
11. Grounded Vision	States why the specific subject is important in general, and for the lecture, lesson and topic in particular.	[1] [5] [11]
12. Objectives about behavioural dispositions	States what the student shall be able to do or achieve, expressed as disposition for behaviour.	[5]
13. Personalised objectives	States the concrete and observable comportment the student will master after instruction.	[5]

Tables 1 shows the set of proposed user-friendly metadata that are of a purely pedagogical/didactical type, Table 2 lists those which serve a more general descriptive goal. In order to make the usage of each individual item as clear as possible, for each item both, a definition, and similarly named fields by other (technical) standards have been included.

**Table 2:** User-friendly metadata of a more general descriptive type

Field Name	Definition	Source
1. Title	Prominent first line, heading etc. that also visually stands out from the rest of the document.	[1] [11] [12] [13]
2. Language	Language the document is perceived to be written in. E.g. English, German, French etc	[1] [11] [12] [13]
3. Keyword	Perceived content of the document through <i>words</i> that have been grabbed while skimming the document.	[11] [12] [13]
4. Granularity Type	Size indication of the available material. E.g.: Exercise, individual lesson, entire course.	[1] [11]
5. Visual appearance	Overall picture of a document, i.e. its visually perceived look and structure.	[12]
6. Document type	Defines a basic, commonly known document prototype. E.g.: letter, picture, form, presentation, news paper article, manual etc.	[12]
7. Last updated	<i>Precise and approximate</i> day and/or time when the document in question was created or used latest	[1] [12]
8. Perceived educational importance	Judgement rating applied to a given piece of e-learning material, based on characteristics such as its type, layout etc.	[12]
9. Material quality	Judgement rating applied to a given piece of e-learning material, based on the evaluation of a) experts and b) users of the material	[12]

#### 4 Discussion and Conclusion

The discussion on the appropriateness of metadata descriptors is not new in general. It has so far not come up yet with respect to e-learning but only for the domains of Information Retrieval, Personal Information Management and Information Sciences. Arising problems in this context have always been overseen based on the argument that teachers seemed rather reluctant to share material with one another on such a public basis as e-learning systems. We however are of the opinion that this is not quite correct as has been proven by successful educational web servers such as EducETH in Switzerland [4] and ZUM in Germany [15], both of them managed and maintained by volunteering teachers.

The success of these servers comes first and foremost from two facts:

1. *Appropriate support for the creators of e-learning material:* Hardly any extra effort is required from the publishing teachers for the sake of content management, neither with respect to work flow nor with respect to the provision of characterisations (the later metadata) for the published material. Ease of use and efficiency for the publishers is therefore the key issues, but it is nevertheless among the most important weaknesses of e-learning systems.
2. *Appropriate support for the users to find and access e-learning material:* Both, teachers and students, are rapidly and intuitively able to find the material at their disposition. A well working approach in this context, is the *step-wise specification refinement* strategy to look for material.

In this two aspects, the lack of teacher- and student-friendly metadata for the description of the material is certainly one point where improvement is most necessary. No doubt, metadata - in a technical sense - is needed as soon as content must be managed and maintained. It is however not only the technical system that needs to be properly supported, but also the employing educators and students. For them, the metadata descriptors they are obliged to deal with, must be well understandable and readily applicable.

To overcome these obstacles, we have in this paper on the one hand compiled a list of requirements which are to be met by user-friendly metadata, and on the other also made a proposition for a set of

metadata that we think adequate. It seems only justified, that none of the listed descriptors is entirely novel, didactics and information systems engineering are after all a well covered disciplines and have provided a good basis to build on.

In our eyes, future work will be needed to evaluate the present proposition out in the field. The questions that need to be addressed are: Does the proposed list contain the correct set of descriptors? What kind of amendments are required when it comes to practical application? What other requirements need to be met in order to make e-learning systems truly usable? As can be inferred from these questions, a lot of effort has to be invested still, in order to create truly usable e-learning systems.

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