eLearning, Metadata and Metadata Standards

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What is eLearning?

Learning with computers
Learning with the internet
Multimedia Learning
Learning with fun and play
CBT
CSCL
... WBT
CAI

Take part in an American course out of our bedroom
What is eLearning?

<table>
<thead>
<tr>
<th>First term</th>
<th>Second term</th>
<th>Third term</th>
</tr>
</thead>
<tbody>
<tr>
<td>Computer</td>
<td>Assisted</td>
<td>Instruction</td>
</tr>
<tr>
<td>Web</td>
<td>Aided</td>
<td>Learning</td>
</tr>
<tr>
<td>Based</td>
<td></td>
<td>Cooperative Learning</td>
</tr>
<tr>
<td>Enhanced</td>
<td>Education</td>
<td></td>
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<tr>
<td>Mediated</td>
<td>Training</td>
<td></td>
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<tr>
<td>Interactive</td>
<td>Teaching</td>
<td></td>
</tr>
<tr>
<td>Supported</td>
<td>Study</td>
<td></td>
</tr>
</tbody>
</table>

**Select one from each column**

Definition of eLearning

- No universally accepted definition until now
  - “Young” term, coined approximately in 1998 (origin: internettime.com)
  - Rapid changes of eLearning technologies and market
- No clear definition of the term

“The use of information and computer technologies to create learning experiences”
Other definitions of eLearning

- “eLearning is what takes place entirely within a Web browser”
- “eLearning is the delivery of content via all electronic media, including the Internet, intranets, extranets, satellite broadcast, audio/video tape, interactive TV, and CD-Rom.” (Minass, 2002)
- “But no matter what you call it, e-learning is really about one thing: using technology to give people the knowledge they need to do their jobs.” (Minass, 2002)

- “eLearning is Internet-enabled Learning. Components can include content delivery in multiple formats, management of the learning experience, and a networked community of learners, content developers and experts. eLearning provides faster learning at reduced costs, increased access to learning, and a clear accountability for all participants in the learning process. [...] Cisco Systems” (Minass, 2002)
- “Teaching and learning with and in the internet.” (Thomas Baumann, 2003)
- “eLearning is the use of information and computer technologies to create learning processes.” (Horton, 2006)
e stands for… ?

- Electronic Learning
  - Historical definition

- Enhanced Learning
  - Focus on learning opportunities

- Experience Learning
  - Focus on participation, interaction, monitoring

- Enriched Learning
  - Focus on contents, multimedia, hypermedia

Varieties of eLearning

- Standalone courses
  - Self-directed learning
  - Without interaction with instructors or classmates

- Virtual-classroom courses
  - Structured much like a classroom course
  - May or may not include synchronous online meetings

- Learning games and simulations
  - Learning by performing simulated activities that require exploration and lead to discoveries

- Embedded eLearning
  - eLearning included in another system, such as a computer program, a diagnostic procedure, or online help
Varieties of eLearning

- **Blended Learning**
  - Use of various forms of learning to accomplish a single goal
  - May mix classroom and eLearning or various forms of eLearning
- **Mobile learning**
  - Learning from the world while moving in the world
  - Aided by mobile devices such as PDAs and smartphones
- **Knowledge management**
  - Broad uses of eLearning, online documents, and conventional media
  - To educate entire populations and organizations rather than just individuals

...
eLearning types

- Accidental learning
  - Exposition to large amount of unstructured content

- Self-directed learning
  - Structured content, unstructured learning experience, no personalization

- Supported learning
  - User guidance, personalization, design of learning experience

- Collaborative learning
  - Peer-to-peer interaction, cooperative process

Competencies for eLearning

- Pedagogy / methodology
  - Added value: quality of teaching and learning
  - Instructional design: learning scenarios
  - Motivation: psychological theories

- Psychology of learning
  - Added value: structure, preparation and presentation of learning material
  - Perception and learning theory, especially with respect to multimedia
  - Cognitive load, multiple coding, multiple perspectives, multimedia learning principles
Competencies for eLearning

- Multimedia conception and screen design
  - Added value: practical methods and tools for usability and cognitive processing
  - Designing motivational eLearning components
  - Creating digital multimedia objects for learning: video, simulation, graphics, audio, …

- Technical development, software engineering
  - Integration of technologies to create and facilitate a sound eLearning
  - Modularization of learning objects
  - Categorization, specification, evaluation of learning systems

eLearning development process

- Apply methods of software engineering
  - What about the role of educational theories in the development process?
  - How do media design and media didactics influence the development?

- Use Instructional Design Theories
  - Technical aspects are neglected…
  - How to ensure feasibility?

\[
\text{eLearning Design} = \text{instructional design} + \text{ICT design}
\]
Instructional design

- Practice of arranging media and content to help learners and teachers transfer knowledge most effectively
- Process
  - determining the current state of learner understanding
  - defining the end goal of instruction
  - creating some media-based “intervention”
- Pedagogically tested theories of learning
- Outcome of the instruction: directly observable and scientifically measured or completely hidden and assumed

Influences on eLearning development

- Instructional design
  - Contributes theories about how humans learn
  - Can guide selection and specification of new kinds of learning experiences
- Media design
  - Helps to select the appropriate combination of text, graphics, voice, sound, animation and video
  - Helps to sequence and synchronize media
Influences on eLearning development

- **Software engineering**
  - Helps to build reliable computer programs
  - eLearning software has a user-interface, may draw content from a database, transmits media over networks, …
  - Contributes concepts of object design, usability design, prototyping
- **Economics**
  - eLearning must be developed under a budget restrictions and on schedule

Cognitive map for eLearning

- pedagogy
  - media didactics
  - educational methodologies
  - competencies
- behaviorism
- motivation
- constructivism
- perception
- cognitivism
- learning theories
- psychology
- organization
- legal issues
- change management
- economy
- presentation
- eLearning standards
- coding
- storage formats
- digital media
- distribution
- technology
**Learning object**

- Any entity, digital or non-digital, that may be used for learning, education or training
- Generally applies to educational materials designed and created in small chunks for the purpose of maximizing the number of learning situations in which the resource can be used
- Link to the constructivist learning theory

**Learning objects and educational units**

[Diagram showing relationships between curriculum, course, lesson, topic, learning object, activity, cognition map for eLearning, standards, formats, coding, distribution, presentation, storage.]
Learning objects’ granularity

- “Long enough to cover the topic and short enough to be concise”
- Useful and reusable digital components that:
  1) state a learning objective
  2) present content
  3) provide opportunity for practice
  4) assess achievement of the objective

Learning objects and metadata

- Many learning objects are non-textual
  - digitized slides, animations, video clips,…
- Locating learning objects within a digital library can be a challenging task!
- Solution: the use of metadata
Resource and description

- **Resource**
  - Content, format, …
  - Access method dependent on format (I can read it if I “know” its language)

- **Resource description**
  - Independent of the format (I can read “people’s comments” about the resource… provided that I know the language in which the comment is written)

---

Resource and description

- **Description**
  - this resource is suitable for PhD students

- **Resource**
  - the title of this resource is "Introduction to the Semantic Web"
  - the author of this resource is L. Farinetti
  - the quality of this resource is high, according to F. Corno
  - this resource was created on April 14th, 2009
  - this resource is related to computer science, knowledge representation and metadata
Resource and description

• Resource
  ◦ Content, format, …
  ◦ Access method dependent on format (I can read it if I “know” its language)

• Standardization (i.e. common language for applications) ???
  ◦ Practically impossible …
  ◦ Huge amount of existing information
  ◦ Hundreds of human languages
  ◦ Hundreds of computer languages (other word for formats)

Resource and description

• Resource description
  ◦ Independent of the format (I can read “people’s comments” about the resource… provided that I know the language in which the comment is written)

• Standardization (i.e. common language for applications) ???
  ◦ Feasible
  ◦ Smaller amount of information, possibly new
  ◦ Solution: define a standard language for writing comments (“metadata” in semantic web terminology)
the title of this resource is “Introduction to the Semantic Web”.

the author of this resource is L. Farinetti.

the quality of this resource is high, according to F. Corno.

this resource is suitable for PhD students.

this resource was created on April 14th, 2009.

this resource is related to computer science, knowledge representation and metadata.

Field name = field value

Metadata

Title = “Introduction to the Semantic Web”

Author = L. Farinetti

Quality = high

Rated by F. Corno

Level = PhD students

Date = 2009-04-14

Topic = {computer science, knowledge representation, metadata}
Meaningful metadata annotations

- Common language for describing resources
  - Resource description standards
- Common language for description field names
  - Metadata standards
- Common language for description field values
  - Metadata standards + controlled vocabularies
- Semantically rich descriptions to support search
  - Knowledge representation techniques, ontologies

Common language for describing resources

- Diagram:

```plaintext
Author = L. Farinetti

URI hasAuthor L.Farinetti
```

- Simple RDF assertion (triple):

```
triple (hasAuthor, URI, L.Farinetti)
```
Common language for describing resources

- RDF in XML syntax:

```
< RDF xmlns="http://www.w3.org/TR/... " >
  < Description about="http://www.polito.it/semweb/intro" >
  < Author > L. Farinetti </ Author >
  </ Description >
</ RDF >
```

Common language for field names

- Problem

- Topic = ...
  - Topics, Subject, Subjects, Argument, Arguments
  - Singular / plural

- Level = ...
  - Educational level, destination, suitability, ...

- Date = ...
  - Date of creation, date of last modification, date of revision, ...
  - Different concepts; need for more details

- Title = ...
  - Educational level, destination, suitability, ...

- Author = ...
  - Creator, Maker, Contributor ...
  - Synonymy
Common language for field names

- Solution: metadata standards
- Many standardization bodies are involved
- Standards may be general
  - e.g. Dublin Core (DC)
- or may depend on goal, context, domain, ...
  - e.g. educational resources (IEEE LOM), multimedia resources (MPEG-7), images (VRA), people (FOAF, IEEE PAPI), geospatial resources (GSDGM), bibliographical resources (MARC, OAI), cultural heritage resources (CIDOC CRM)

Metadata standards examples

<table>
<thead>
<tr>
<th>Standardization Body</th>
<th>MARC</th>
<th>Dublin Core</th>
<th>CDWA</th>
<th>VRA Core</th>
<th>CSDGM</th>
<th>Z39.85</th>
<th>LOSI</th>
<th>DRSGS</th>
<th>MIETE</th>
<th>JPEX</th>
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</table>

<table>
<thead>
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<th>Art</th>
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<th>Art</th>
<th>Images</th>
<th>Art</th>
<th>Images</th>
<th>Art</th>
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<tr>
<td>Domain</td>
<td>Bibliographic media description</td>
<td>Bibliographic media description</td>
<td>Description of Acts of works</td>
<td>Description of images of Acts of works</td>
<td>Description of Geographic media</td>
<td>Description of still images</td>
<td>Description of educational media</td>
<td>Description of digital objects</td>
<td>Description of digital images</td>
<td>Description of digital images</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Level</td>
<td>Largely semantic</td>
<td>Largely semantic</td>
<td>Largely semantic</td>
<td>Largely semantic</td>
<td>Semantic and technical</td>
<td>Technical</td>
<td>Largely semantic</td>
<td>Technical</td>
<td>Semantic and technical</td>
<td>Semantic and technical</td>
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<td></td>
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<td></td>
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</tr>
</tbody>
</table>
Dublin Core

- Dublin Core Metadata Element Set (DCMES)
  - Building blocks to define metadata for the Semantic Web
  - 15 elements, or categories, general enough to describe most of the published resources
  - Extra elements and element refinements

Common language for field values

- Problems
  - Value type

```plaintext
Title = "Introduction to the Semantic Web"
type = string

Date = 2009-04-14
type = date

Author = L. Farinetti
type = string
"standard" format?
Laura Farinetti, Farinetti Laura, Farinetti L, …
```
Common language for field values

- **Problems**
  - Value type
  - Value restrictions?
    - freedom vs shared understanding

- **Solution**: metadata standards + controlled vocabularies

  - **Metadata standards**
    - Only some, and partially

  - **Controlled vocabularies**
    - Explicit list of possible values
Examples from IEEE LOM

  - Developed by the IEEE Learning Technology Standards Committee (LTSC)
- Standard to describe the “Learning Objects” in order to guarantee their interoperability
### Examples from IEEE LOM

#### Example 1

<table>
<thead>
<tr>
<th>No</th>
<th>Name</th>
<th>Explanation</th>
<th>Size</th>
<th>Order</th>
<th>Value space</th>
<th>Data type</th>
<th>Example</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.2</td>
<td>Title</td>
<td>Noun given to the learning object.</td>
<td>3</td>
<td>unspecified</td>
<td>LongString (size: parameter: 1000 bytes)</td>
<td>&quot;Cesare: The life and works of Leonardo da Vinci&quot;</td>
<td></td>
</tr>
</tbody>
</table>

#### Example 2

<table>
<thead>
<tr>
<th>No</th>
<th>Name</th>
<th>Explanation</th>
<th>Size</th>
<th>Order</th>
<th>Value space</th>
<th>Data type</th>
<th>Example</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.3</td>
<td>Language</td>
<td>The phrase/languages of languages used within the learning object to communicate the intended text.</td>
<td>15</td>
<td>unspecified</td>
<td>LanguageCode</td>
<td>Language</td>
<td>&quot;en&quot;</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Note 1: An administrator or cataloging tool may permit a world-wide-English.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Note 2: If the language used has no language code as defined in the code list (ISO 639-1988 and subsequent editions may occur as arbitrary extension of (from) a country code form the code set ISO 3166-1 (1997).</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

#### Example 3

<table>
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<tr>
<th>No</th>
<th>Name</th>
<th>Explanation</th>
<th>Size</th>
<th>Order</th>
<th>Value space</th>
<th>Data type</th>
<th>Example</th>
</tr>
</thead>
<tbody>
<tr>
<td>2.3.1</td>
<td>Date</td>
<td>Kind of constitution.</td>
<td>1</td>
<td>unspecified</td>
<td></td>
<td>Vocabularies (IS0)</td>
<td>-</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Note 1: (if necessary) the author(s) of the learning object should be described.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Note 2: (if necessary) the author(s) of the learning object should be described.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

#### Example 4

<table>
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<th>No</th>
<th>Name</th>
<th>Explanation</th>
<th>Size</th>
<th>Order</th>
<th>Value space</th>
<th>Data type</th>
<th>Example</th>
</tr>
</thead>
<tbody>
<tr>
<td>2.3.2</td>
<td>Entity</td>
<td>The identification of the information about persons (e.g., people organizations forming the learning object. The information should be ordered in most relevant first.</td>
<td>6</td>
<td>unspecified</td>
<td>LongString (size: parameter: 1000 bytes)</td>
<td>Name/URI</td>
<td>John Smith (<a href="mailto:john@smith.com">mailto:john@smith.com</a>) (URI)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Note 1: (if necessary) the author(s) of the learning object should be described.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Note 2: (if necessary) the author(s) of the learning object should be described.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

#### Example 5

<table>
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<th>Explanation</th>
<th>Size</th>
<th>Order</th>
<th>Value space</th>
<th>Data type</th>
<th>Example</th>
</tr>
</thead>
<tbody>
<tr>
<td>2.3.3</td>
<td>Time</td>
<td>The time of the creation.</td>
<td>1</td>
<td>unspecified</td>
<td>Date/Time</td>
<td></td>
<td>&quot;2001-08-27&quot;</td>
</tr>
</tbody>
</table>
... + controlled vocabularies

<table>
<thead>
<tr>
<th>No</th>
<th>Name</th>
<th>Explanation</th>
<th>Type</th>
<th>Order</th>
<th>Value space</th>
<th>Domain</th>
<th>Example</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Keyword</td>
<td>A keyword or phrase describing the topic of the querying object. This data element should not be used for descriptions that can be described by other data elements.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

- A closed list of named subjects, which can be used for classification
- Metadata field values are restricted to a list of terms (selected by experts)

Semantically rich descriptions to support search

http://dictybase.org/db/html/help/GO.html

Topic = \{computer science, informatics, knowledge representation, metadata\}
Educational metadata

- Describe any feature of a learning object
- Facilitate educational institutions to provide suitable information about their course supply
- Facilitate learners in retrieving learning objects
- Classified in
  - Syntactical metadata
  - Semantic metadata

Educational metadata

- Syntactical metadata
  - Describe the structural characteristics of a learning objects, such as format, language, technical requirements, target group, author
- Semantic metadata
  - Describe the semantic content of a learning object, such as keywords
  - Links to domain-specific taxonomies or ontologies
Dublin Core

- Dublin Core Metadata Initiative (DCMI)
  - organization dedicated to promoting the widespread adoption of interoperable metadata standards and developing specialized metadata vocabularies for describing resources that enable more intelligent information discovery systems
  - organized in working groups which deal with specific domains

- Dublin Core Metadata Element Set (DCMES)
  - building blocks to define metadata for the Semantic Web
  - 15 elements, or categories, general enough to describe most of the published resources
  - extra elements and element refinements
**DC Metadata Element Set**

- **Title**
  - a name given to the resource

- **Creator**
  - an entity primarily responsible for making the content of the resource

- **Subject**
  - the topic of the content of the resource (e.g. keywords)

- **Description**
  - an account of the content of the resource

- **Publisher**
  - an entity responsible for making the resource available

---

**DC Metadata Element Set**

- **Contributor**
  - an entity responsible for making contributions to the content of the resource

- **Date**
  - a date associated with an event in the life cycle of the resource

- **Type**
  - the nature or genre of the content of the resource

- **Format**
  - the physical or digital manifestation of the resource

- **Identifier**
  - an unambiguous reference to the resource within a given context (e.g. URI, ISBN, …)
DC Metadata Element Set

- Source
  - a reference to a resource from which the present resource is derived
- Language
  - a language of the intellectual content of the resource
- Relation
  - a reference to a related resource
- Coverage
  - the extent or scope of the content of the resource (e.g. spatial location, time, jurisdiction)
- Rights
  - information about rights held in and over the resource

Extra elements and refinements

<table>
<thead>
<tr>
<th>accrualMethod</th>
<th>creator</th>
<th>language</th>
<th>source</th>
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<tbody>
<tr>
<td>accrualPeriodicity</td>
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<td>provenance</td>
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</tr>
<tr>
<td></td>
<td>available created</td>
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<td>issued</td>
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<td>tableOfContents</td>
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<th>relation</th>
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<tbody>
<tr>
<td>educationLevel</td>
<td>extent</td>
<td>conformsTo hasFormat hasPart hasVersion isFormat isPartOf isReferencedBy isRequiredBy isVersionOf replaces requires</td>
<td></td>
</tr>
<tr>
<td>mediator</td>
<td>medium</td>
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</tbody>
</table>

<table>
<thead>
<tr>
<th>contributor</th>
<th>identifier</th>
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<th>accessRights</th>
<th>license</th>
</tr>
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<tr>
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<th>rightsHolder</th>
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<tbody>
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</tr>
<tr>
<td>temporal</td>
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</tbody>
</table>


IEEE LOM

  - developed by the IEEE Learning Technology Standards Committee (LTSC)
- Standard to describe the “Learning Objects” in order to guarantee their interoperability
- Based also on Dublin Core

IEEE LOM

- Goals
  - to enable learners or instructors to search, evaluate, acquire, and utilize Learning Objects
  - to enable the sharing and exchange of Learning Objects across any technology supported learning systems
  - to enable the development of learning objects in units that can be combined and decomposed in meaningful ways
  - to enable computer agents to automatically and dynamically compose personalized lessons for an individual learner
IEEE LOM

Goals

- to compliment the direct work on standards that are focused on enabling multiple Learning Objects to work together within an open distributed learning environment
- to enable, where desired, the documentation and recognition of the completion of existing or new learning & performance objectives associated with Learning Objects
- to enable a strong and growing economy for Learning Objects that supports and sustains all forms of distribution; non-profit, not-for-profit and for profit

IEEE LOM

Goals

- to enable education, training and learning organizations, both government, public and private, to express educational content and performance standards in a standardized format that is independent of the content itself
- to provide researchers with standards that support the collection and sharing of comparable data concerning the applicability and effectiveness of Learning Objects
- to define a standard that is simple yet extensible to multiple domains and jurisdictions so as to be most easily and broadly adopted and applied
- to support necessary security and authentication for the distribution and use of Learning Objects
### Nine categories

- **General**
  - category groups the general information that describes the learning object as a whole

- **Lifecycle**
  - groups the features related to the history and current state of this learning object and those who have affected this learning object during its evolution

- **Meta-Metadata**
  - groups information about the metadata instance itself (rather than the learning object that the metadata instance describes)
Nine categories

- Technical
  - groups the technical requirements and technical characteristics of the learning object
- Educational
  - groups the educational and pedagogic characteristics of the learning object
- Rights
  - groups the intellectual property rights and conditions of use for the learning object

Nine categories

- Relation
  - groups features that define the relationship between the learning object and other related learning objects
- Annotation
  - provides comments on the educational use of the learning object and provides information on when and by whom the comments were created
- Classification
  - describes this learning object in relation to a particular classification system
Learning Object example

1 General

1.2 General.Title: “Virtual Memory”
1.4 General.Language: “en”
1.5 General.Description: “Architecture and functional properties of computer virtual memories”
1.6 General.Keywords: (“computer”, “computer architecture”, “memory”)
1.9 General.Aggregation Level: “2”

Learning Object example

2 LifeCycle

2.1 LifeCycle.Version: “1.3”
2.2 LifeCycle.Status: “Revised”
2.3.1 LifeCycle.Contribute.Role: “Author”
2.3.2 LifeCycle.Contribute.Entity: “L. Farinetti”
2.3.3 LifeCycle.Contribute.Date: “2005-11-15”
Learning Object example

3 MetaMetaData

3.2.1 MetaMetaData.CatalogEntry.
Catalog: “Ariadne”

3.2.2 MetaMetaData.CatalogEntry.Entry: “KUL510”

3.3.1 MetaMetaData.Contribute.Role: “Author”

3.3.2 MetaMetaData.Contribute.Entity: “S. Mehan”

3.3.3 MetaMetaData.Contribute.Date: “2005-11-23”

4 Technical

4.1 Technical.Format: “text/html”

4.2 Technical.Size: “23560”

4.3 Technical.Location: “www.polito.it/did/comparch/vmem.html”

4.4.1 Technical.Requirements.
Type: “Browser”

4.4.2 Technical.Requirements.Name: “Microsoft Internet Explorer”

4.4.3 Technical.Requirements.MinimumVersion: “5.0”
Learning Object example

5 Educational

5.1 Educational.InteractivityType: “Active”
5.2 Educational.LearningResourceType: “Questionnaire”
5.5 Educational.IntendedEndUserRole: “Learner”
5.6 Educational.Context: “University First Cycle”
5.8 Educational.Difficulty: “difficult”
5.9 Educational.TypicalLearningTime: “PT45M”

Learning Object example

6 Rights

6.1 Rights.Cost: “no”
6.2 Rights.CopyrightAndOtherRestrictions: “yes”
6.3 Rights.Description: “Acknowledge host institution”
Learning Object example

7 Relation

7.1 Relation.Kind: “Requires”

7.2.2 Relation.Resource.Description: “LO on memory architecture”

8 Annotation

8.1 Annotation.Person: “F. Corno”

8.2 Annotation.Date: “2005-11-27”

8.3 Annotation.Description: “Add a more complex example of address translation”
Learning Object example

9 Classification

9.1 Classification.Purpose: “Discipline”

9.2.1 Classification.TaxonPath.Source: “ACM”

9.2.2 Classification.TaxonPath.Taxon: “Computer Science”

9.3 Classification.Description: “Architecture and functionalities of computer virtual memory”

Useful links

- Dublin Core Metadata Initiative
  - [http://dublincore.org/](http://dublincore.org/)
- IEEE LOM