Structuring learning content into Learning Objects (LO)
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Abstract

In our learning content, we make use of learning objects and atomic learning objects. For both of them a set of metadata has been defined. We can differentiate between two kinds of metadata, technical oriented and learning oriented metadata. Learning objects requires both kinds of metadata. Atomic LO's only requires technical oriented metadata. The metadata follows the international standards on learning content. Hereby the interoperability of the objects in different learning systems is being guaranteed.

A learning object is a composition or a scenario model of a set of blocks. The blocks, presenting the smaller learning content parts, are composed of the learning content (full text doc) and of a set of added atomic LO's, being small learning content elements**.**

1. Learning Objects and Atomic Learning Objects.

A learning object (LO) is an independent content component that can function as the learning content of a course module .It can be defined as any digital content resource that supports learning, that can be re-used and that can be delivered on demand across the network, be it large or small. Examples of those larger reusable digital resources include entire web pages that combine text, images and other media or applications to deliver course modules.

A course module consists of a number of blocks representing learning content parts. These learning content parts resulted from a decomposition of the learning content of the course module in smaller content parts (full text).

The learning process on this level is defined as a sequence of a number of steps, corresponding to those blocks.

A learning object is a composition or a scenario model of a set of blocks. The blocks, presenting the smaller learning content parts, are composed of the learning content (full text doc) and of a set of added atomic LO's, being small learning content elements (short text documents, figures, digital images or photos, live data feeds, live or prerecorded video or audio snippets, animations, some questions and answers, some tests, some mouse-over animations, and smaller web-delivered applications).

The architecture of the block (the way all atomic objects have been used) and the composition of the blocks to create a course module (learning object) will be based on a chosen e-learning concept, taking into account a.o. the personal learning styles requirements of the learner.

For those LO's and atomic LO's a set of metadata has been defined following the SCORM standards. The learning objects and the atomic learning objects will be stored and managed in a LOMS (learning object management system).

By defining those learning objects as independent components and by managing them in a warehouse, the re-usability of the learning objects is guaranteed. In case the international standards are followed, the interoperability is guaranteed, and so is the opportunity of potential implementation in different learning management systems (LMS).

2. International defined standards SCORM and the SCO's.

By following the international defined standards on learning content, the inter- operability of the objects in different learning systems is being guaranteed.

Theory is conform the IMS (Instructional Management Systems) standards and specifications and the SCORM (sharable content object reference model) reference model. (http://www.imsglobal.org/metadata/index.cfm). SCORM has been developed by ADL (Advanced Distributed Learning), ADL and IMS being the most important players in the standardisation of learning technology solutions.

A SCO (Sharable content objects) is a set of different assets. The SCO's must be independent to become re-usable.

Another point is the search for learning objects. It is not always easy to find content documents in a large database. The same can be said about the search in a distributed online environment like the World Wide Web or a large intranet. The solution is to store not only learning objects but also descriptions of the learning objects.

3. The metadata.

Thinking of the learning objects as data, the descriptions are data about the data, or metadata. Learning object metadata potentially includes information about the title, author, version number, creation date, technical requirements and educational context and intent. Learning Object Metadata is compatible with the metadata used by the digital and online library community.

SCORM has a place for metadata in every SCO and in every content package.

We base the composition of the metadata on the basic book about "technology and standards used in the development of digital content"(2003) and on the work "using metadata in DU projects (2004), both from the Digital University. (http://www.digiuni.nl).

SCORM differentiates between 3 levels of objects. Different requirements on point of metadata are set forward for the three different levels.

The compulsory metadata consists of the metadata already required for an asset, supplemented with two additional metadata items, the language and the elapsed time.

3.1. Three levels of objects and the requirements on point of metadata

- An asset is a digital content element that cannot be split into smaller content elements. In our e-mindmap concept it corresponds to our atomic learning objects, being the short text and the full text documents, the illustrations, …

The compulsory metadata consists of the title, the description and the copyright. For illustrations the description must be as clear as possible. A description must be a full description of the object.

- A course module or a course will be built by packaging a set of selected SCO's, being stored as a Content Aggregation Model or a CAM.

A special characteristic of a CAM is the possibility of "nesting" different CAM's. A CAM can be compared with our chapter, being a learning path composed of several e-learning units.

- The compulsory metadata consists of the metadata already required in a SCO, supplemented with learning level of the content and the required foreknowledge.

3e level ?

3.2. Metadata of learning objects

Which metadata has to be delivered for the LO's?

We can differentiate between two kinds of metadata, technical oriented and learning oriented metadata. The last one can again be split into characteristics on point of learning objectives and learning styles from one side and learning content characteristics from the other side.

We differentiate between LO's and atomic LO's. The metadata for atomic LO's is limited to technical metadata, because they are linked into a block, not being an individual learning content component. For LO's both learning oriented metadata and technical oriented metadata are needed.

```
┌─────────────────────┐
│ Metadata            │
│                     │
└─────────────────────┘
     ↙              ↘
┌──────────────────────────┐   ┌──────────────────────┐
│ Learning oriented metadata│  │ Technical oriented   │
│                          │   │ metadata             │
└──────────────────────────┘   └──────────────────────┘
     ↓              ↓
┌──────────────┐ ┌──────────────┐
│ Characterist │ │ Characterist │
│ ics of       │ │ ics of       │
│ Learning-    │ │ Learning     │
│ objectives & │ │ content      │
│ styles       │ │              │
│              │ └──────────────┘
│              │
└──────────────┘
```

←——————————————————————————————————→

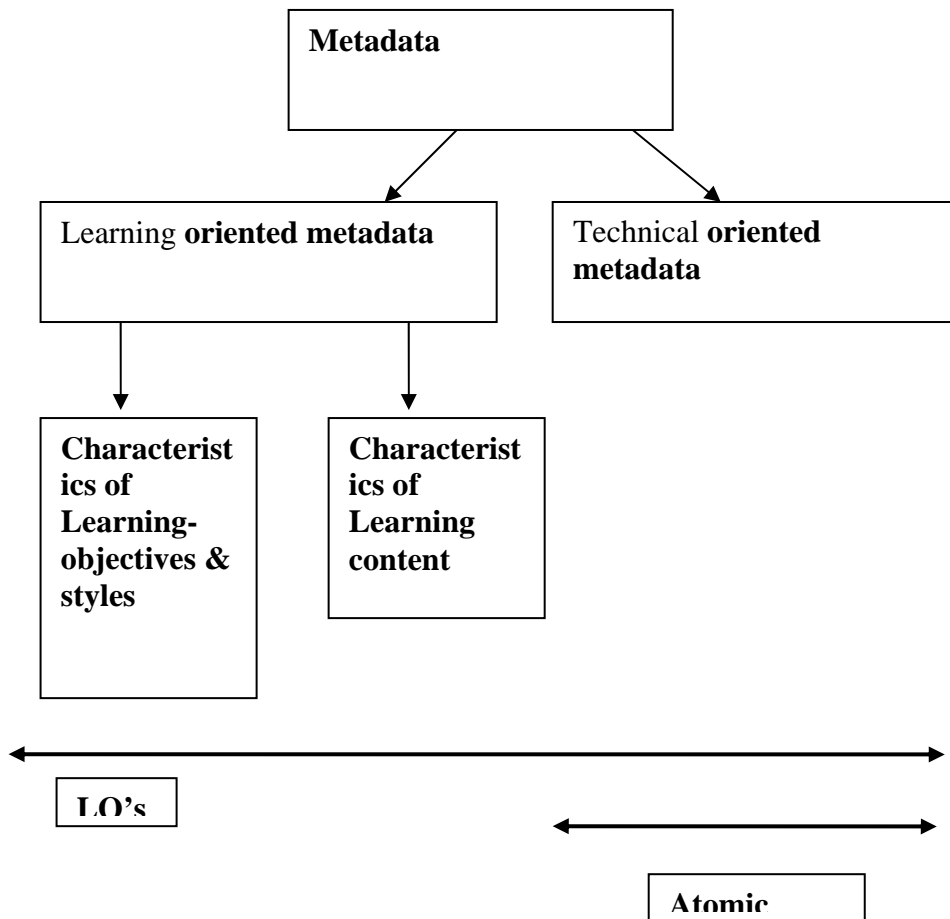LO's

        ←————————————————→

        Atomic

Fig: Levels of metadata

The metadata linked with our atomic objects and the blocks consists of date of creation, format , title, description and copyright.

The learning oriented metadata of a LO consists of learning level, learning domain, title and description. The technical metadata of a LO consists of date of creation, last-adjustment date, elapsed time, language, copyright and format.

4. Learning content decomposition and tree structured content parts or BLOCKS (full text docs)

We are all very familiar with the structure of a book in chapters. It is best to work in accordance with this principle.

A course is similar with a book. A chapter contains many blocks, being smaller content parts.

If the chapter can really be split into more individual content topics, or which can be learned as individual topics, than the learning content is split into two or more units, but the units are put together. So the learner will learn them as one logical content unit.

Each unit is composed of some blocks, corresponding to some smaller content parts.

An introduction in a topic can be an individual block too

As in an introductory chapter of a book, we can have the opportunity to deliver a very fast reading of the content of the course. By the way the student can start by reading the introduction.

The learning content can be found as full text documents in the blocks.

Those blocks are structured in a tree structure. The relation between a block and another block of lower level (a sub block) is defined as: "can be explained as" or "consists of" or other explaining expressions.
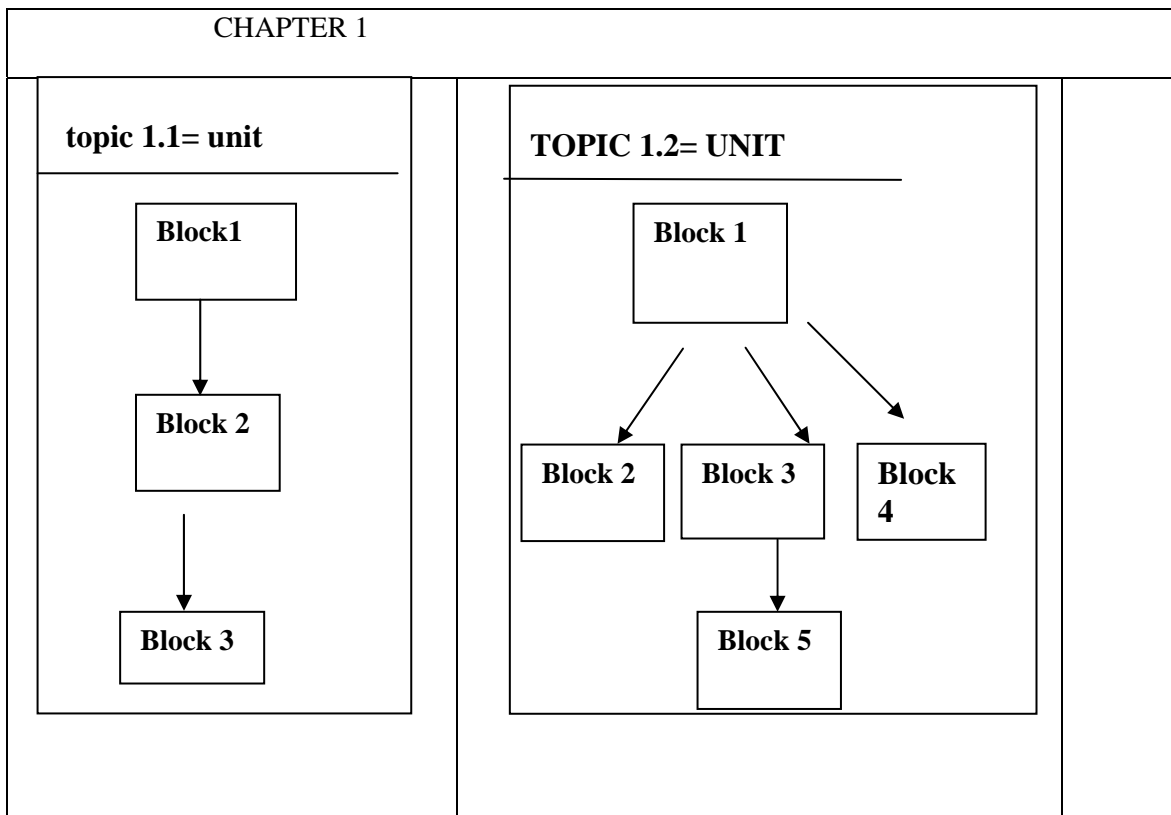
1.CHAPTER

    1.1.UNIT

        1.1.1.Block

            1.1.1.1.Sub-block1

            1.1.1.2. Sub-block2

        1.1.2.block

…
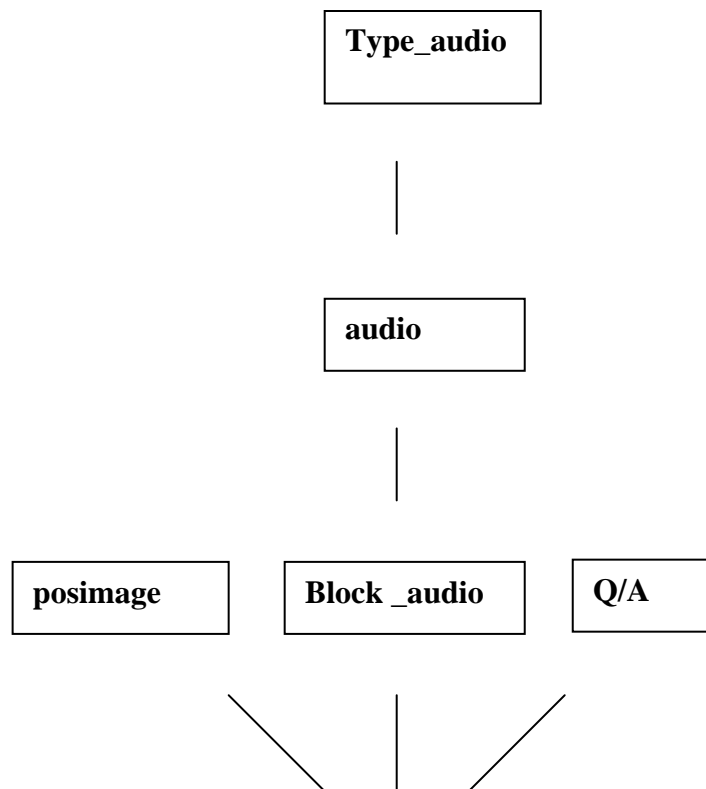
Following figure shows the structure of a chapter.
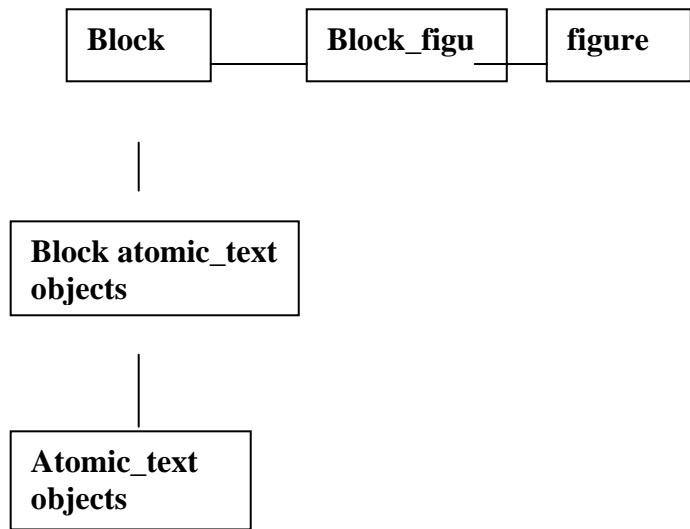
5. BLOCKS and datamodel.

A learning object is a composition of a set of blocks. The block is kernel of the data-model of the learning object. The block is composed of several atomic learning objects.

The learning content included in the block (being the full text document) will be supplemented with other supporting, interactive and animating elements, being all presentation components put above the content component. Some of the presentation components are content related and others are more design/format related.

An example of content related presentation component: some one tells the story of a best practice. An example of design related presentation component: a live picture of the story teller is shown on the screen

Following is the block datastructure:

Type_audio

|

audio

|

posimage   **Block _audio**   **Q/A**

```
┌──────────┐     ┌──────────────┐     ┌──────────┐
│  Block   │─────│  Block_figu  │─────│  figure  │
└──────────┘     └──────────────┘     └──────────┘
     │
     │
┌──────────────────┐
│ Block atomic_text│
│ objects          │
└──────────────────┘
     │
     │
┌──────────────────┐
│ Atomic_text      │
│ objects          │
└──────────────────┘
```

Block (Relation with block_audio, block_atomic_textobjects, block_figure, posimage and Q/A)

Id_block	int	autoincrement
Id_audio	int	
Creation_date	date	
Format	text	
Copyright	text	
Title	text	
Description	text	
Id_Q/A	int	

Block_audio (Relation with block and audio)

Id_block	int
Id_audio	int

Audio (Relation with block_audio and type_audio)

Id_audio	int	autoincrement
Creation_date	date	
Format	text	
Copyright	text	
Title	text	
Description	text	
Audio	text	
Id_type_audio	int	

Type_audio (Relation with audio)

Id_type_audio	int	autoincrement
Description	char	

Block_figure (Relation with block and figure)

| Id_block | int |
| Id_figure | int |

Figure (Relation with block_figure)

Id_figure	int	autoincrement
Creation_date	date	
Format	text	
Corpyright	text	
Description	text	
Title	text	
Figure	text	

Qa (Relation with block)

Id_Q/A	int	autoincrement
Question		text
Answer		text

Posimage (Relation with block)

Top	int
Links	int
Kindofimage	char

Id_block	int
Rotatie	int

Block_atomic_textobjects (Relation with block and atomic_textobjects)

Id_block	int
Id_atomic_textobjects	int

Atomic_textobjects (Relation with block_atomic_textobjects,id_type)

Id_atomic_textobjects	int	autoincrement
Creation_date	date	
Format	text	
Copryight	text	
Description	text	
Title	text	
Id_type	int	
Text	text	

6.A Learning Object is the result of a composition of blocks or is a scenario model.

We can create different compositions or scenario models of the set of blocks to present the learning content to the learner as an e-learning course module. The blocks are the building blocks and linked with them are the basic atomic learning objects.

Not only the blocks are presented in a different composition, the blocks themselves differ in architecture by using the atomic learning objects on a different way.

Following the traditional "web-pages e-learning "concept, we can built a tree structured html scenario model. We can bring together the full text docs of all blocks and put them in the pre-defined tree structure. On this time the block, being a html page must be designed using the presentation of the full text and the other atomic elements, being figures, hypertext links, Q&A, keywords, audiofragments, … can be linked with it following the design of the scenario model.

```
┌──────┐   ┌──────────────┐   ┌──────────────┐   ⬡──────────────⬡
│Meta- │   │e-course-mod  │   │BLOCK_        │  │ The          │
│data  │───│              │───│e-course-mod  │──│ BLOCK        │
│      │   │              │   │              │  │ data         │
└──────┘   └──────────────┘   └──────────────┘   │ structure   │
                                                  ⬡──────────────⬡
```
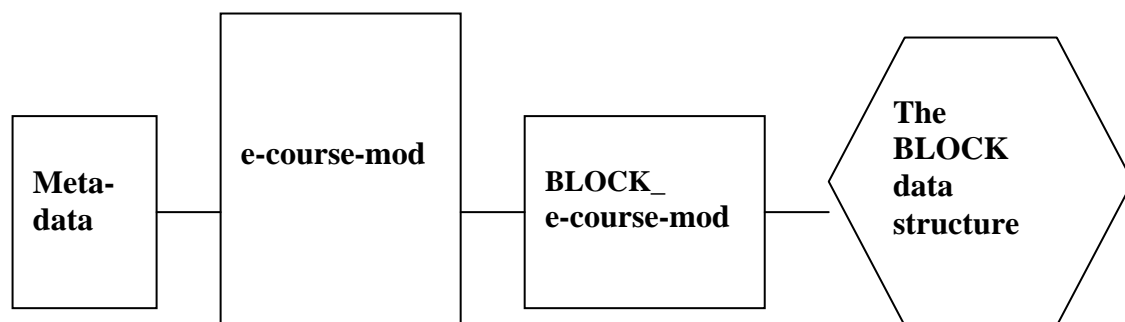
Following the e-MINDMAP concept, we can build an EDUMAP scenario model.

We can organize the blocks in a graphical way in units and in EDUMAPS.   Relevant atomic objects are the full text, the short text, figures, video's, ….

The datamodel is very similar to this of the previous scenario model.