

# Searching for a more effective use of Educational Metadata in a Brazilian educational context

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## Abstract

*This paper presents e-Labora Laboratory ongoing developments and researches to provide support to a more effective use of educational metadata in a Brazilian educational context. This work is based on the IEEE LOM Application Profile defined to the TIDIA-Ae Project.*

**Keywords:** *learning objects, LOM, application profile.*

## 1. Introduction

With the arrival of the Internet, sharing information has become much simpler, faster and more effective. This has promoted a rapid explosion of available digital content and its easy access on the network. This tremendous volume of information needs to be adequately organized and explored in order to more readily retrieve information that is relevant to specific needs of individuals at any given moment.

Metadata is information used to describe digital content, making possible its localization, retrieval and re-use. According to Friesen, Fisher & Roberts [1] "*Metadata acts similarly to a record in a library catalogue, providing controlled and structured*

*descriptions for books, recordings, and 'resources' generally through searchable attributes such as title, author, date, location, description and subject.*" In the case of educational resources, sets of metadata are proposed to identify and meaningfully describe characteristics relevant to these resources, for example, the learning resource type, the intended end user, difficulty level, educational goal, etc.

The concept of educational metadata is intimately related to the notion of Learning Objects (LO), which, although there lacks a consensus as to its definition, can be defined as any educational resource of any sized granule (from a simple image file to the content of an entire course) that can be retrieved, combined and used to attend one or more educational objectives. In order for more effective and meaningful retrieval and reutilization, the learning objects should be cataloged according to educational metadata. In this way, it becomes possible to search for learning objects according to the educational metadata registered for them.

Various repositories of learning objects have been created, and the use of educational metadata has been fundamental to enable more refined searches according to educational characteristics of the content in these repositories.

In an effort to facilitate the interoperability among various different repositories of learning objects, several research groups have proposed specifications

and standards for educational metadata. The IMS Global Learning Consortium, proposed the IMS Metadata Specification<sup>1</sup>, later submitted to the IEEE Learning Technology Standards Committee (LTSC), giving rise to the IEEE LOM (Learning Object Metadata) standard of educational metadata [2], which is currently the standard of reference for educational metadata.

LOM proposes 77 metadata elements distributed in nine metadata categories to describe a LO. Of these, 58 are “active” elements, in other words, they can be filled. The LOM categories are described briefly below [2]:

- **General:** groups the general information that describes the LO as a whole;
- **Life Cycle:** describes the history and current state of the LO and those entities that affected the LO during its evolution;
- **Meta-Metadata:** describes the metadata record itself (rather than the LO described by the record);
- **Technical:** describes the technical requirements and characteristics of the LO;
- **Educational:** describes the key educational or pedagogic characteristics of the LO;
- **Rights:** describes the intellectual property rights and conditions of use for the LO;
- **Relation:** defines the relationship between the LO and other LO, if any;
- **Annotation:** provides comments on the educational use of the LO, and information on when and by whom the comments were created;
- **Classification:** describes where the LO falls within a particular classification system (for example: discipline, idea, prerequisite, educational objective, accessibility restrictions, etc.).

As a standard for educational metadata to be used in various contexts, the IEEE LOM covers a large scope, it contains a broad set of metadata elements, and is open to many possible interpretations and uses [1]. A standard can be adapted to the specific needs of a community, giving rise to an application profile of the standard [3]. In this way, an application profile of metadata can be defined as a combination of metadata elements whose objective is to compose a set of elements adapted to the features and needs of a given context.

Friesen [4] presents a survey of the implementations and uses of a few LOM application profiles. The results of the survey indicate many problems in the current implementation of educational metadata, in particular, the small number of metadata elements that have actually been used: in general, only  $\frac{1}{2}$  to  $\frac{2}{3}$  of the “active” elements (those that can be filled) in the LOM are in fact filled. In addition, the use of the elements in the Educational category is not as effective as expected for a set of “educational” metadata.

Recent studies in the field of educational metadata offer a few hints as to how to pursue the more effective use of educational metadata:

- A smaller and better defined set of metadata elements should be defined according to the features and needs of the community who will make use of the information. Special attention should be given to the elements that represent the educational characteristics of the learning objects [4];
- In order to allow for the filling of metadata by users who may not be specialized in metadata standards, greater focus on the definition of more meaningful terminology (closer to common sense knowledge) is necessary for the metadata elements [5][6];
- Research is needed in the fields of Human-Computer Interfaces and Artificial Intelligence in order to promote tools that make the filling of the educational metadata more automatic. According to Norman [*apud* 6], a technology is only successful when the end users do not perceive its presence. In other words, its use becomes so natural that we don’t even notice it. This is one of the challenges in the field of educational metadata – to create tools that make the cataloging of the metadata “invisible” to the end user [6].

The current article presents the initial results of the work that is being developed in the TIDIA-Ae project relating to educational metadata. The TIDIA-Ae project has a group working specifically on the analysis and adaptation of specifications and standards of electronic learning to be adopted in the project, with special focus on the standards related to the development of digital educational content. Within the scope of this working group, a few studies were developed on the definition of an application profile of the LOM standard for the Brazilian educational setting, in search of a subset of LOM elements which can promote the more effective use of

<sup>1</sup> <http://www.imsglobal.org/metadata/>

educational metadata in this context. The TIDIA-Ae application profile is presented briefly in section 2.

In support of the effective use of the defined application profile, the e-Labora development laboratory has conducted research and development on the use of the proposed application profile. Section 3 presents some of the partial results already obtained, as well as proposals for future research and development.

## 2. The TIDIA-Ae LOM Application Profile

An IEEE LOM application profile was defined in the TIDIA-Ae project in an effort to more closely reflect the educational context. In this way, the group sought to obtain a set of metadata that would allow for a more meaningful description of the characteristics of the learning objects produced, facilitating more effective searches, use and reuse of the objects.

In order to define an application profile according to the IEEE LOM standard for the TIDIA-Ae project, in addition to the LOM standard [2], the recommendations for the implementation of LOM found in [1] [7] [8] were analyzed, as well as other application profiles based on this standard, such as the Cancore<sup>2</sup>, SCORM<sup>3</sup>, Celts, UK LOM Core and Learning Federation<sup>4</sup>. This definition is based upon the following basic requirements:

- Maintain the maximum conformity with the LOM, assuring greater inter-functionality with other application profiles within this standard (as with the Cancore, UK LOM Core, Ariadne, SCORM, etc.);
- Define a minimum core set of LOM elements that are essential for the identification of the learning object and that should be mandatory. This core set should guarantee an adequate representation of the educational characteristics of the learning objects;
- Identify unnecessary or not recommended elements that can be disregarded in the application profile;
- Analyze the need for extensions of the LOM elements for a more meaningful description of

the learning objects within the Brazilian context;

- Define vocabularies and classification taxonomies adapted to the Brazilian educational setting, yet maintaining the ability to map them onto the LOM standard recommended vocabulary in order to preserve conformity with this established standard.

Based on these requirements, the Nucleus Campinas proposed an IEEE LOM Application Profile [9], that evolved to the TIDIA-Ae LOM Application Profile adopted by the TIDIA-Ae Workgroup 2. The TIDIA-Ae Application Profile basically divides the LOM metadata elements into 4 subsets:

- **Mandatory elements** (27 total / 18 active): defined in order to make possible a minimal identification of the cataloged LOs and the interoperability with other LOM profiles, like SCORM. The TIDIA-Ae mandatory elements subset include:
  1. Some of the metadata in the **General** category (*LO Identifier, Title, Language, Description and Keyword*);
  2. A few elements from the **LifeCycle** category (*LO Version and Contribute Entity, Role and Date*);
  3. Some elements from **Meta-Metadata** category (*the LO metadata record Identifier, Metadata Schema used*);
  4. One element from **Technical** category (*the LO attached files Formats*);
  5. A few elements from the **Educational** category that are needed to identify the educational characteristics of the learning objects (*the Intended End User Role and the Context where it is intended to be applied*);
  6. A few elements in the **Rights** category needed for the description of the copyright options adopted for the learning object;
- **Optional elements** (37 total / 30 active): elements not required to be filled, nevertheless, should be filled whenever possible;
- **Recommended elements** (7 total / 4 active): a special category of optional elements that are

<sup>2</sup> <http://www.cancore.ca/>

<sup>3</sup> <http://www.adlnet.org/>

<sup>4</sup> <http://www.thelearningfederation.edu.au/>

“strongly recommended” to be filled and should be supported and verified by the cataloging systems. Some of the elements in the Classification category of the LOM are in this subset as they provide for the classification of the LOs in relation to a few purposes such as “discipline” (target subject area for which the LO was created), “idea” (main topic), “educational goal” (intended educational objective), which are very important for the educational description of the LOs;

- **Not recommended elements** (6 total / 6 active): certain elements from the IEEE LOM were not adopted in the TIDIA-Ae application profile either because they are not relevant to the description of learning objects within the context in question or they have been proven by other studies on application profiles, such as that described in Friesen, Fisher & Roberts [1], to be difficult to use. The following LOM elements were not considered: *1.6 Coverage, 1.7. Structure, 5.1 Interactivity Type, 5.3. Interactivity Level, 5.4. Semantic Density.*

A table containing a comparison between the metadata elements of the LOM and the TIDIA-Ae profile is presented in Appendix.

The effectiveness of the defined application profile for cataloging learning objects in the Brazilian educational context should be initially tested by research groups within the TIDIA-Ae Project that are developing learning objects and who will use this application profile to catalog the generated contents. There also needs to be a more in depth study of the definition of vocabularies and classification taxonomies adapted to the Brazilian educational context, this being anticipated for the subsequent phase of the Project.

The next section presents research and developments that are being elaborated in e-Labora Laboratory in support of the use of the proposed application profile.

### **3. Support for the use of educational metadata**

With the objective of promoting the effective use of the educational metadata, as well as the definition of an application profile adapted to the Brazilian educational setting, it is necessary to provide support tools for the use of this metadata. In this way, the e-Labora Laboratory has developed several studies and

proposed future research and development described in the following subsections.

#### **3.1. Definition of more meaningful terminology for the elements of educational metadata**

This study was developed jointly with the Content Group of e-Labora (responsible for the planning of learning actions and for the development of the educational content used in these actions). The goal of this study was to define a clearer and more meaningful terminology that could facilitate the understanding of the educational metadata elements in the TIDIA-Ae application profile by users who are not specialists in the area.

The development of this study was also important in that it allowed for the Content Group of e-Labora to become familiar with the TIDIA-Ae profile of educational metadata and with the process of cataloging a LO. The proposed terminology should be refined and validated during the cataloging of content generated in the learning actions by the Content Groups from other laboratories affiliated with the TIDIA-Ae Project.

#### **3.2. LO Cataloging Tool**

A LO Cataloging Tool was developed at the e-Labora in order to test and validate not only the TIDIA-Ae metadata application profile but also the proposed terminology to facilitate the understanding of the metadata elements in the profile. The tool was design collaboratively, with the participation of the members of the Content Group at e-Labora. The main design suggestions obtained in this process include (Figure 1):

- Internationalization: the interface was implemented in two languages (in English, using the original LOM terminology, and in Portuguese, with the terminology proposed by the Content Group at e-Labora) (Figure 2);
- Separation of the categories of metadata in different tabs;
- Separation of the Meta-metadata category, since it is the only one that is not related to the LO but to the cataloging of the LO;
- Identification of the required elements (they appear in bold);
- Provision of HELP for filling each element of metadata.

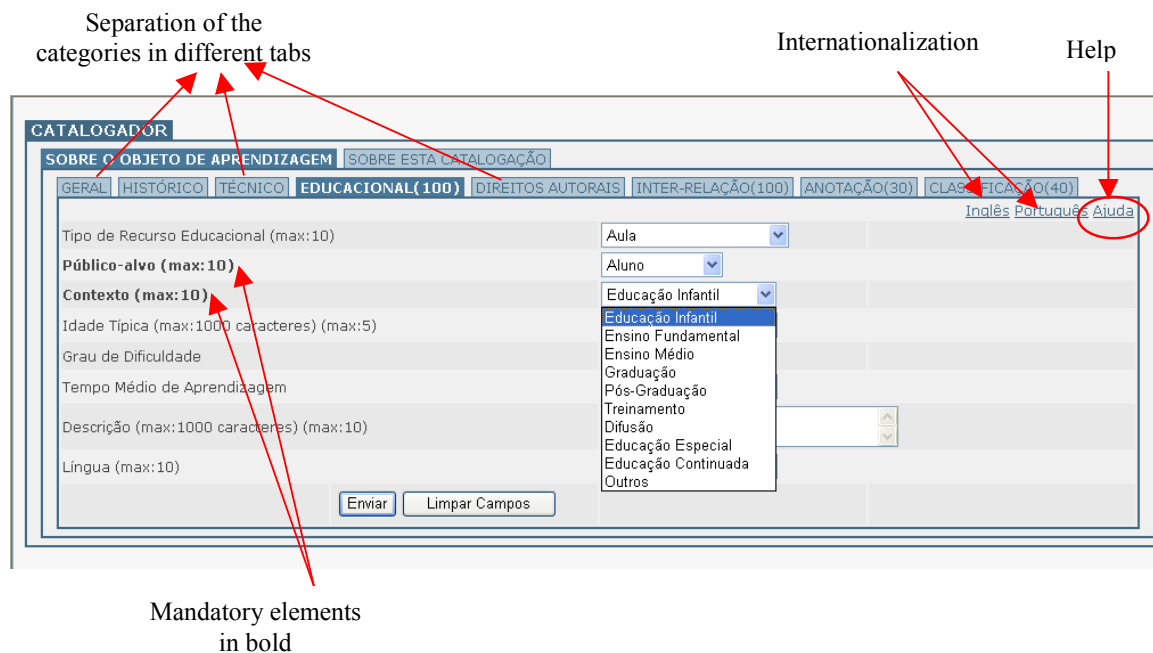


Figure 1 - LO Cataloging Tool suggested design

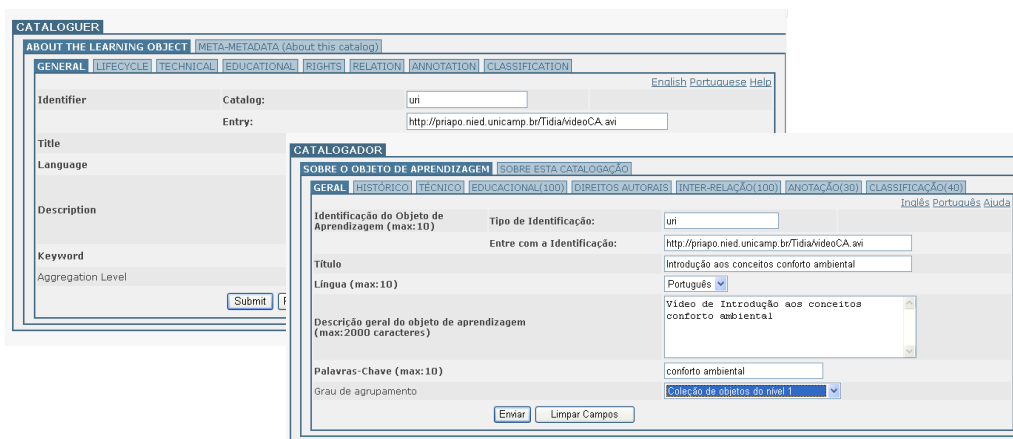


Figure 2 - LO Cataloging Tool : English version (original LOM terminology) and Portuguese version (suggested terminology)

In the future, this tool should be integrated into the TIDIA-Ae electronic learning environment, making possible the automatic filling of some of the elements of metadata from the cataloged LOs. For example, the information about the creator/reviser of a metadata register could easily be captured from the data registered on the users of the LMS.

Considering the cataloging of learning objects that are being used within the context of a learning action (whether it be a set of activities that make up a course, one course module, a workshop, etc.) developed in the LMS, it is very likely that the LO can “inherit” the various metadata defined for the context of the learning action, such as, target-context

defined for the learning action (*Context*), target user role defined for the learning action (*Intended user role*), and classification of the discipline or target subject of the learning action (*Classification*). In this way, one can provide the option to capture contextual data during cataloging.

### 3.3. Creation of an LO from the contents generated in a LMS

During a learning action developed in a LMS, various types of content is generated and stored, from the log of a chat session, the messages in a discussion forum, to the planning of an activity or the generation of a document using a tool for collaborative writing integrated into the environment. A large part of the content generated within the scope of a learning action has the potential to be relevant educational material and could be reused in other actions.

In this way, the TIDIA-Ae project intends to promote mechanisms to facilitate the creation of learning objects from content generated in the environment. A major part of the educational metadata on these learning objects can easily be retrieved since they are strongly related to the context of the learning action in which they were created.

In the TIDIA-Ae Project the tools in the environment are being designed to store metadata that facilitate the future cataloging of data generated from each tool. Using the Discussion Forum as an example, we can capture the following metadata during the course of the development of an activity (Figure 3):

- During the planning of an activity that will be developed in the Discussion Forum tool, one can collect certain metadata like the forum title (*Title*), the initial forum description (*Description*), the classification in relation to the topic or subject of the forum activity (*Classification*), the primary language that will be used by the forum participants (*Language*), the forum creator (*Life cycle. contribute.role= "initiator"*), and the indication of relationship to the support materials for the forum (*Relation.kind = "references"*). Also, users with the role of forum mediators can be defined (*Life cycle.contribute.role= "subject matter expert"*);
- Some metadata can be captured directly from the data in the learning action in which the forum was created, as presented in section 3.2;
- During the realization of the forum activity, the messages and their authors are registered, this being the content of the learning object resulting from the register of the participations in this activity. The participants can be considered authors of the learning object (*LifeCycle.contribute.role= "author"*);
- When the forum activity is finalized, the participant who finalized the activity is registered (*LifeCycle.contribute.role= "terminator"*).

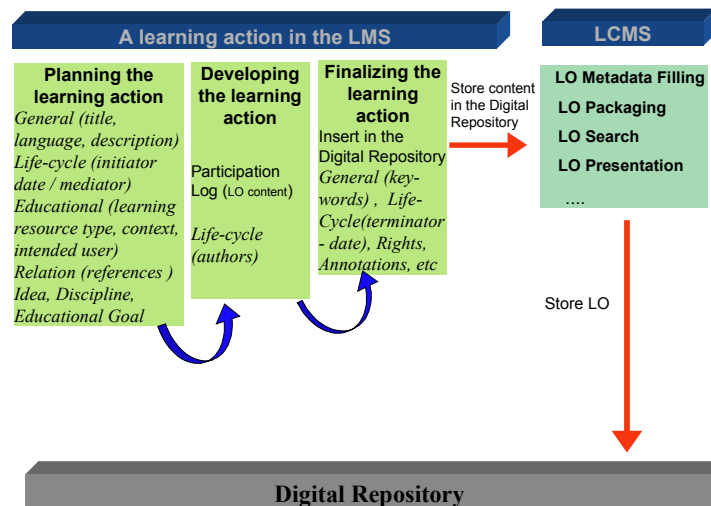


Figure 3 - Metadata capture through the content development process

After closing a discussion forum, its register becomes available to be “exported as LO”, in other words, to be cataloged with the educational metadata and packaged in a standardized format defined to promote the interoperability among systems that wish to import, export, aggregate and disaggregate content packages (the most widely used standard is the IMS Content Packaging<sup>5</sup>).

In this way, at the moment in which the option is made to “transform” the forum content into a learning object and store it in a digital content repository, a large portion of the necessary metadata for its cataloging could be retrieved automatically by the cataloging tool integrated into the learning management system which supported the activity. A cataloging tool could then present a form with the fields filled automatically and solicit confirmation or revision of these fields, as well as provide the option to fill fields that could not be filled automatically.

#### 4. Final Considerations

This article presents the initial directions of the work within the scope of the TIDIA-Ae project, aiming to promote support for the more effective use of educational metadata within the Brazilian setting. A proposal is made for an Application Profile adapted to the Brazilian educational context and an overall view of the research and development proposed in support of the use of this profile.

The TIDIA-Ae Metadata Application Profile reflects an initial survey of the metadata needed to describe learning objects within the Brazilian educational context. Nevertheless, this profile will be further refined based upon the validations that will be run by other researchers in the project who are involved in the creation of digital educational content.

The objective of the studies related to the development of tools to support the use of educational metadata that are being developed and proposed by e-Labora is to facilitate the process of cataloging LOs (in terms of the volume of information to be filled and the clarity of the terminology adopted). Future work will involve research in the fields of Artificial Intelligence, Human-Computer Interface and Information Visualization, aiming towards solutions that can make the cataloging in this metadata “invisible” to the end user, as recommended by Durval & Hodgins [6].

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<sup>5</sup> <http://www.imsglobal.org/content/packaging/>

## 6. Appendix – TIDIA-Ae Metadata Application Profile

LOM elements	TIDIA-Ae Profile
1:General	M
1.1:Identifier	M
1.1.1:Catalog	M
1.1.2:Entry	M
1.2:Title	M
1.3:Language	M
1.4:Description	M
1.5:Keyword	M
1.6:Coverage	N
1.7:Structure	N
1.8:Aggregation Level	O
2:LifeCycle	M
2.1:Version	M
2.2:Status	O
2.3:Contribute	M
2.3.1:Role	M
2.3.2:Entity	M
2.3.3:Date	M
3:Meta-Metadata	M
3.1:Identifier	M
3.1.1:Catalog	M
3.1.2:Entry	M
3.2:Contribute	O
3.2.1:Role	O
3.2.2:Entity	O
3.2.3:Date	O
3.3:MetadataSchema	M
3.4:Language	O
4:Technical	M
4.1:Format	M
4.2:Size	O
4.3:Location	O
4.4:Requirements	O
4.4.1:OrComposite	O
4.4.1.1:Type	O
4.4.1.2:Name	O
4.4.1.3:Minimum Version	O
4.4.1.4:Maximum Version	O
4.5:Installation Remarks	N
4.6:Other Platform Requirements	O
4.7:Duration	O

5:Educational	M
5.1:Interactivity Type	N
5.2:Learning Resource Type	O
5.3:Interactivity Level	N
5.4:Semantic Density	N
5.5:Intended End User Role	M
5.6:Context	M
5.7:Typical Age Range	O
5.8:Difficulty	O
5.9:Typical Learning Time	O
5.10:Description	O
5.11:Language	O
6:Rights	M
6.1:Cost	M
6.2:Copyright and Other Restrictions	M
6.3:Description	O
7:Relation	O
7.1:Kind	O
7.2:Resource	O
7.2.1:Identifier	O
7.2.1.1:Catalog	O
7.2.1.2:Entry	O
7.2.2:Description	O
8:Annotation	O
8.1:Entity	O
8.2:Date	O
8.3:Description	O
9:Classification	R
9.1:Purpose	R
9.2:TaxonPath	R
9.2.1:Source	R
9.2.2:Taxon	R
9.2.2.1:Id	R
9.2.2.2:Entry	R
9.3:Description	O
9.4:Keyword	O

M - Mandatory elements  
O - Optional elements  
R - Recommended elements  
N - Not recommended elements