Evaluating a Brazilian Metadata to Learning Objects to Web, Mobile and Digital Television Platforms

Júlia Marques Carvalho da Silva, Rosa Maria Vicari

Federal University of Rio Grande do Sul
Postal Code 15064, Porto Alegre/RS, 91501-970, Brazil
julia.silva@bento.ifrs.edu.br, rosa@inf.ufrgs.br

Abstract. The paper presents an evaluation of a specification for metadata for learning objects and platforms developed for web, digital TV and mobile devices. For this, we present the two most widely used specifications, IEEE LOM and Dublin Core, and specification OBAA. The evaluation was divided into two stages, the first with expert and the second with professors. The results of the first are presented in this paper.

Keywords: Learning Objects, Metadata, OBAA.

1 Introduction

To date, there isn't a unique definition for the concept of learning objects. This is done by the various understandings among researchers who use this technology. One of the definitions most used to IEEE LOM [8], propous that a learning object is "any entity, digital or not, which can be used for teaching, education or training". This definition allows physical materials (books, handouts, games, etc.) and digital (web pages, audio and video files, or software) may be considered learning objects. We noticed that in this context, the focus takes place in the didactic material, and not in storage, identification, reusability, durability, etc.

From the last 10 years, the learning objects has been studied by organizations, such as IEEE, which develop specification documents. These specifications create mechanism that orients the description and classification of the instructional content, called "metadata"; and a mechanism that assure the indexing and retrieving of learning object in the digital libraries or repositories.

Currently, there are two specifications of metadata used to learning objects that are accepted by many researchers: the IEEE LOM (maintained by IEEE institute) and Dublin Core (maintained by Dublin Core Metadata Initiative). The IEEE LOM [8] is considered a complete model, and is focused on learning objects, digital or not. However, it is also considered hard to fill the data because it is too extensive. The Dublin Core [4] has 15 elements, which includes the most used elements used by teachers and instructional designers. Moreover, it can be used for any digital resource.

Learning objects were projected to web platform generally. However, since web 2.0 and the digital convergence, new platforms had used to educational purpose. Digital interactive television and mobile devices are two examples.

In 2008, Brazil launched a research announcement to develop a Brazilian metadata standard to learning objects. The main requirement is to work in the web, mobile and digital television platforms. The proposal accepted was OBAA (in English, Learning Objects Based on Agents). A multidisciplinary team from Education, Accessibility, Artificial Intelligence and Digital Television areas proposed a set of metadata to the standard. The differential of OBAA is the possibility to describe instructional contents to web, mobile and digital TV platforms, while IEEE LOM and Dublin Core is limited to web. OBAA presents metadata to pedagogical support, which helps teacher to identify and orient how to use the learning object. The pedagogical model has epistemological interactionism bases, which comprehends that the one who knows the world by its interaction with the other objects (situations, animals, objects). Therefore, OBAA has metadata to describe the accessibility information of learning objects and allows the segmentation of the content; specially used to large content of audio and video [1].

Existing researches related to learning object metadata present purposes and new specifications, few discussing how metadata assist in indexing and retrieval, and especially in educational planning, that is, how teachers make use of these metadata. This study aims to identify how the metadata of OBAA standard help define the technological and pedagogical requirements of multiplatform learning objects and how teachers base on these requirements for planning the use of these learning objects in the classroom. Therefore, the research methodology adopted in this study is qualitative and quasi-experimental, which attempts to understand how metadata can help teachers in their search and selection, and then the teaching planning of learning objects. Thus, it was necessary to conduct experiments and even compare the metadata OBAA with the IEEE LOM and Dublin Core.

This paper is organized as follows: initially it presents the concepts of metadata, and how they apply to learning objects. Following is presented the methodology of the project and partial results of the analysis of the experts. Finally, it is presented considerations and future work.

2 Learning Objects Metadata

Metadata is defined as any kind of information that in some way referees or describes aspects of some other piece of information, or “data about data”. In addition, metadata allows systems to manage resources without ever having to delve into their physical or digital internals [13].

In an e-learning context, metadata may consist of many kinds of information about a learning object. It may be used by cataloguing software for indexing, be learning management systems for matching learners with relevant resources, and by content players that configure the learning object to the user’s environment and needs [13].

Currently, there are many metadata standards that store technical and pedagogical information. We present three standards bellow.

2.1 IEEE LOM

The IEEE LOM scheme consists of a single hierarchy of 76 elements divided into nine categories, and specifies vocabularies and allowed syntaxes for the value of each element. It can be used to convey not only metadata useful for resource discovery, but also information such as aspects of the lifecycle of a learning object and pedagogical features [8]. The categories are presented below:

- General: groups the general information that describe the learning object as a whole;
- Lifecycle: groups the features related to the history and current state a learning object and those who have affected this learning object during its evolution;
- Meta-metadata: groups information about a metadata instance itself (rather than a learning object that the metadata instance describes);
- Technical: groups the technical requirements and technical characteristics of a learning object;
- Educational: groups the educational and pedagogic characteristics of a learning object;
- Rights: groups the intellectual property rights and conditions of use for a learning object;
- Relation: groups features that define the relationship between a learning object and other related learning objects;
- Annotation: provides comments on the educational use of a learning object and provides information on when and by whom the comments were created;
- Classification: describes a learning object in relation to a particular classification system.

Among those categories, we mainly focus on General (Coverage and Language metadata), Educational (Intended User Role, Context and Typical age Range metadata) and Classification. We made this choice based on the pre-requisites for cultural aspects.

2.2 Dublin Core

The Dublin Core Metadata Element Set [4] is a vocabulary of fifteen properties used in resource description. The elements described are part of a larger set of metadata vocabularies and technical specifications maintained by the Dublin Core Metadata Initiative (DCMI). The elements of Dublin Core (version 1.1) are:

- Coverage: the spatial or temporal topic of the resource, the spatial applicability of the resource, or the jurisdiction under which the resource is relevant;
- Description: may include but is not limited to: an abstract, a table of contents, a graphical representation, or a free-text account of the resource;

- Type: the nature or genre of the resource;
- Relation: a related resource;
- Source: a related resource from which the described resource is derived;
- Subject: will be represented using keywords, key phrases, or classification codes;
- Title: a name given to the resource;
- Contributor: an entity responsible for making contributions to the resource;
- Creator: an entity primarily responsible for making the resource;
- Publisher: an entity responsible for making the resource available;
- Rights: information about rights held in and over the resource;
- Date: a point or period of time associated with an event in the lifecycle of the resource;
- Format: the file format, physical medium, or dimensions of the resource;
- Identifier: an unambiguous reference to the resource within a given context; and,
- Language: a language of the resource.

2.3 OBAA

As already presented in the introduction, OBAA (Learning Objects Based on Agents) consists of a Brazilian specification for learning objects. It originated in 2008, an edict from the Ministries of Education, Communication, and Science and Technology, which sought proposals for dealing with the interoperability of digital content across multiple platforms, including: web, mobile devices and television digital interactive. This requirement is based on the fact that the Brazilian government presents several initiatives on educational context.

The project has a multidisciplinary team divided into four main areas: accessibility, artificial intelligence, pedagogical, and interactive digital television. The team was responsible for the development of the first product from the project: a document specifying a set of metadata for learning objects OBAA.

During the elaboration of specification of metadata, it was necessary to investigate other specifications, in particular in the area of educational resources [8, 9], and multimedia files [10, 12]. As a result, it was obtained a set of metadata for learning objects that includes the following features:

- Multiplatform (there are elements which allow the identification of technical requirements for web platforms, mobile devices and interactive digital television);
- Compatibility with other specifications (OBAA was designed based on the IEEE LOM, where new metadata were added to it, thus maintaining compatibility between the two specifications, in addition to direct correlation between the element OBAA and Dublin Core).
- Inclusion and expansion of metadata related to accessibility, education and segmentation, and,
- Combination of artificial intelligence technologies to learning objects (multi-agent systems and ontologies).

The metadata specification OBAA was based on IEEE LOM, as illustrated in Figure 1. The justification given by the IEEE LOM specification to be considered as more appropriate and used by researchers in the field of learning objects. Furthermore, it wanted to maintain compatibility with the specification statements, which are possible to be based on IEEE LOM. Therefore, the categories of the IEEE LOM metadata have been maintained. Creating new elements created for the categories 4.Technical and 5.Educational (highlighted in bold in Figure 1), and created two new categories, 10.Accessibility and 11. Segment Information Table (Figure 1, highlighted in bold italics).

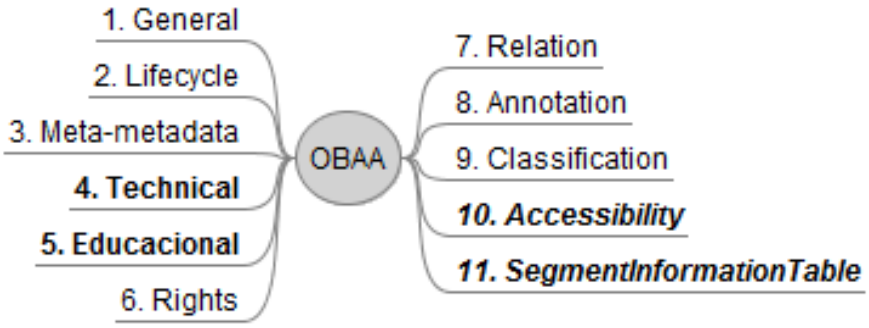

Fig. 1. OBAA metadata categorizes

3 Problem and Methodology

This research aims to identify how the metadata of learning objects can assist in educational planning. Metadata and technical education are emphasized because they are considered crucial in the act of planning. A teacher can focus on or disregard a learning object by technological restrictions. The same way, pedagogical metadata are essential in choosing the learning object, because the teacher needs to know the content, the level of appropriate education, and level of interactivity to the learning object requires.

It is noticed that several researches related to metadata of learning objects have new specifications [7, 11, and 15] but do not evaluate how they are used in practice. Therefore, this study verifies the metadata as technical and educational learning objects are used and what is its importance in educational planning.

The research was divided into two stages. The first sought to discover and describe the metadata specifications, and from case studies, examining how the metadata help identify technical and pedagogical learning objects. Among several metadata specifications have been chosen to IEEE LOM, Dublin Core and OBAA, the latter being the focus work. This was carried out with experts in metadata and the results are presented in this paper.

Teachers perform the second stage based on the analysis of metadata and technical education. For the analysis, it will be used focal group technique, where teachers will be meeting in small groups, allowing participants to give their opinion without preconceptions, through a detailed analysis of the product [6]. The choice of this

technique is justified because OBAA is a new specification, with recent scientific work.

So, the research methodology adopted involves qualitative research and quasi-experimental. In [5] the author claim that qualitative research seeks a better understanding of a phenomenon subject studied, while [3] refines this concept, reporting that its purpose is to describe and understand social phenomena based on the meaning that people give it. For this, the research questions are studied by flexible methods allowing contact with the people involved.

In qualitative research, it is used a variety of empirical materials: case studies, personal experience, introspection, life story, interviews, artifacts, cultural texts and productions, which describe routine and problematic moments and meanings of individuals [5]. For this paper, some of these instruments were used, which are presented in this section.

On the other hand, the quasi-experimental research "... the research outlines do not have random distribution of subjects by treatment nor control groups [14]. The comparison between the conditions of treatment and no treatment should be made with no equivalent groups or with the same subjects before the treatment.

For the initial research conduction, it was applied the technique of direct documentation. It is constituted in collecting data on the spot where the phenomena occur, where the data can be obtained in two ways: through field research or laboratory research. In this work, the direct documentation was obtained through research on official documents of specifications for metadata of educational resources: Dublin Core, IEEE LOM and OBAA. Still, it was studied some examples of metadata files of defined learning objects in each of the specifications. As a result, we obtained a textual descriptive report on the specifications presented in Section 2 of this paper.

4 Data Analyses

The analysis and interpretation of data is configured from two studies. The first refers to analysis by three experts, which focuses on the manner in which technical and pedagogical metadata enables the indexing and retrieval of learning objects, by its identification by the metadata. This analysis is presented in sequence.

In the second analysis, called of analysis of subject-teachers will be checked how teachers observe the metadata in planning use of learning objects in their classes. In this analysis, it will be checked which elements teachers consider relevant evidence to support the task of educational planning and, subsequently, what elements are present in their lesson plans. This second analysis will be conducted in the next stages of the project.

4.1 Specialist Analyses

As described above, the analysis of experts seek to collect opinions on the set of metadata OBAA, having as the verification strategy, and the use of case studies. In this analysis, it is observed that by the experts have accompanied the process of

creating OBAA; it would not be interesting to analyze the specification Dublin Core and IEEE LOM, as they've looked at that on previous moment, when elaborating the OBAA. Therefore, it is not necessary here to have discussions about the Dublin Core specification to be directed to any digital resource and the IEEE LOM propose to educational resources in general, and consequently, how this is reflected in each set of metadata.

In the analysis, three experts participated. All of them with a master's degree and with studies and publications in the area of metadata for learning objects and activities contribute in the construction of metadata OBAA in different areas. Initially we established some characteristics, which are desired to observe, in line with the objective of the work. From the characteristics, it was created four case studies and selected learning objects that fit to each case study. Learning objects used were extracted from the repository International Bank of Educational Objects [2]. Learning objects are in Portuguese, because it is a Brazilian repository, except the object of learning from case study 4, which has a version in Portuguese and English.

Case study 1: Multiplatform learning object

- The goal is to verify the potentialities and limitations of metadata of a learning object with content suitable for all three platforms (web, mobile and digital TV). The learning objects selected based on video in the AVI extension. It features two games: a Burquinha and Disc Wheel. The Burquinha consists of a game with marbles, where the goal is to bring the ball to the hole. Since the Wheel-Disc is a game of tag, where the participants must move from one extreme to the other singing a determined song. When moving, the participant must avoid being caught by the "tagger". To not get caught, the player must sing the song correctly or run fast. Children make the presentation and demonstration of the games.

Case study 2: learning objects with similar themes and different technological characteristics

- The goal is to verify the potentialities and limitations of two learning objects whose contents are the same but using different technologies, i.e., how the metadata are able to differentiate these learning objects. We selected two learning objects related to the short story "The Fortune Teller," Machado de Assis. The first one is an animation that tells the story, leading to suspense to the student and encouraging him to read the story to know the ending. It was developed using Flash technology, and because it is an animation, it looks like a video, telling those tale of the early passages in summarized form. The second object of learning is the complete text of the story available in PDF format. There is no interactivity or picture that illustrates the story. Therefore, the material favors the printing of the story for its reading.

Case study 3: learning objects with pedagogical content and similar technological characteristics

- The goal is to verify the potentialities and limitations of two learning objects, whose contents and technologies used are those same, i.e., how the metadata are able to differentiate these learning objects. Learning objects selected

using the same technology (Flash) and deal with the same content (Abacus), yet they are pedagogically different.

Case study 4: Same learning objects in different languages

- The goal is to verify the potentialities and limitations of two identical learning objects (same content and technology), but presented in different languages, i.e., how the metadata are able to differentiate these learning objects. Learning objects chosen relate to the teaching of alkaline fuel cell. They are learning objects identical (same technical content and pedagogical), but presented in different languages (English and Portuguese).

We noted, then, that the focus of this analysis focuses on the analysis of metadata and how they are able of identify different learning objects. The choice of this form of analysis is justified on the premise that a set of metadata to enable the indexing and retrieval of learning objects, identifying them and presenting them properly in the repositories.

4.2 Report of the Analysis of Case Studies by the Experts

The first topic was discussed with the experts on what is understood about the technical and pedagogical metadata. Initially, it was reported that deal with educational and technical categories, though it was shown that other elements of other categories could be regarded as indirectly teaching: notes (annotation), classification (classification) and Relations (relation). It was discussed whether the job should then consider whether or not these elements, in which it chose not to consider them, since they are already bound by the IEEE LOM. Yet, as the objective is to evaluate the metadata specification OBAA, the focus should be on the elements added in OBAA, which were not included in other specifications.

Following, we presented the four case studies proposed for discussion. For a case study, which discusses the platform, it was concluded that the metadata OBAA are bound to such a proposal, not being necessary modifications. The discussion went to the case where there is need of different media to meet accessibility requirements. However, the subject is not part of the scope of this work.

In case study 2, we presented the two learning objects, whose contents are similar, using different technologies. Initially, it was questioned whether the learning objects could not become a single one, to promote accessibility, because, starting from the premise that while a learning object uses the Flash technology (using greater interactivity) and other learning object uses only plaintext, the second could be used by the visually impaired (with screen readers). However, in dealing with learning objects with different technologies, it was reported that in this case, we are dealing with two different learning objects, which have their own metadata and can be related to the element of relation (relation). Once again, no need for modifications regarding the technical and educational metadata.

The case study 3 dealt with learning objects with similar technology and similar content. In this case, we can see that from the point of view of technical and

pedagogical metadata may be close. Differentiation between them will give by the authorship, or other elements present in OBAA.

The case study 4, considered two learning objects technically and educationally equals, though presented in different languages. The learning object has a single author, so the metadata will be equal, in which the only distinction will be the language used. It was questioned whether this case would not be similar to the objects of multiplatform learning, which has a same learning object only with variations to suit different platforms. Still, it was questioned whether this language variation was not characterized in an accessibility requirement, considering that the possibility of offering a video with the language of the deaf can also be considered as sign language. In conclusion, the experts felt that these are two learning objects, and therefore each must have its own set of metadata though most elements have identical values.

After the analysis, some topics were discussed which were not in the case studies, which are presented below:

- Establish new kinds of relation: the category 7. Relations (relation) presents values considered technical that enable us to relate the learning object with those references used for their construction, or with other learning objects that add the theme we're working on. From the standpoint of the teacher, the current values do not allow the relations of their everyday life, e.g. to relate a learning object that contains one text to another learning object that presents an illustration, that is, which is exemplifying speech. Therefore, we suggest the creation of new types of relationships in order of meet the needs of the instructional designer, which establishes those Relations of aggregation and reference with other learning objects, and the needs of teachers who seek to exemplify, implement, conceptualize or have some alternative material to the learning object that is being worked on.
- The OBAA also allows the description of physical objects (not digital): although the documentation OBAA report that it is possible the description of learning objects based on web platforms, interactive digital television and mobile devices, it is not limited to digital content. For relying on IEEE LOM, and this allows the use of metadata for description of digital learning objects or not, OBAA also allows physical objects to be described by it. Thus, in the case of description of a physical object, the element 4.1Format, will receive the value "non-digital", the Location 4.3 will contain a physical description of where the object is, and if you need special equipment The 4.5.Installation Remarks describe the equipment name (e.g., a DVD containing a movie, you need a DVD player and a television for display). Finally, it should be noted that the category 11. Segmentation already supports the non-digital learning objects description, with no compatibility issue.
- The OBAA presents metadata whose data types for values to be filled were not defined, for elements created, in particular, the elements 10 and 4:10 service. Accessibility is a brief description of what must be completed (a string of characters) or just the element name (no data type or examples of valid values). It is perceived the need to define such data in order to consolidate and improve the specification.

- The OBAA presents metadata whose values are valid in English (based on IEEE LOM) and Portuguese (new elements) according to the history of the project OBAA initially sought to maintain compatibility with the IEEE LOM, thus the metadata and filling in the values were kept in the original language (English). Recently, there has been interest in regulating the specification and submit to the agency that regulates those Brazilian technical standards, ABNT, which will require the use of Portuguese language for specifying the metadata. Experts believe that to maintain compatibility with the IEEELOM (and ensure reuse); the metadata inherited from IEEE LOM should be kept in English, while the metadata can be created by OBAA in Portuguese or English.

Finally, the group sought a definition for what would then be considered a learning object OBAA, which revealed the following conclusion: a learning object OBAA consists of a teaching resource, digital or not accompanied by a set of information (metadata), which will allow its cataloging, even in the case of learning objects whose pedagogical objective is maintained, and there are only technological change, it is for metadata describe this, and keep a single learning object, but if the learning objects make different educational goals, each will have its own metadata file, regardless of whether the technology or languages are similar or different.

5 Future Trends and Contributions

Learning objects are digital content or not, used for educational purposes. Learning objects are different from educational software because they establish mechanisms that ensure the indexing and retrieval of content in repositories. Therefore, specifications were created with the aim to standardize what information is needed for storage of content, creating metadata specifications.

Currently there are some specifications, where each one serves a purpose: digital resources or not, educational content, multi-platform, features of educational sites, etc. Among the existing specifications, are: IEEE LOM, Dublin Core and OBAA. These three were presented throughout this work.

The researches related to metadata of learning objects have proposed new specifications, little exploring how metadata is used. In particular, how the primary users (teachers) use them when planning their lessons. Therefore, this paper presented a work that aims to identify how teachers use the technical and pedagogical metadata in pedagogical planning. The work was divided into two parts. The first sought to do a survey on existing specifications, describing in greater detail, the most commonly used and specification OBAA (research focus). Still, we conducted an evaluation of metadata experts, using the technique of case study. Each case study has built in a scenario with specific characteristics. Finally, a descriptive report was prepared with the considerations taken in the case studies and other observations during the evaluation. In general, the OBAA was considered a complete specification, for it considers physical learning objects and digital multi-platform. Besides, it was possible to identify learning objects with very similar pedagogical and technical characteristics.

Among the future work is the evaluation of the metadata by teachers. Through focal group technique, teachers with different teaching time experience and area will be gathered. In each group the technical and pedagogical metadata will be presented for the teachers discuss what metadata is relevant to them. Finally, we will ask teachers to prepare lesson plans using a learning object whose metadata will be provided. At this stage, we will verify what metadata really are present in this lesson plan. Therefore, it is expected that this work contribute to the research in learning object metadata, providing a form of evaluation from the view of teachers and their pedagogical planning.

References

1. Bez, M. R., Silva, J. M. C., Santos, E., Primo, T., Bordignon, A. OBAA project: An approach to interoperable learning objects based on Web and digital television. In: World Conference on Computers in Education, Bento Gonçalves, Rio Grande do Sul (2009)
2. Banco Internacional de Objetos Educacionais – BIOE, http://objetoseducacionais2.mec.gov.br/
3. Boeije, H. R. Analysis in Qualitative Research. SAGE Publications (2009)
4. Dublin Core metadata element set, version 1.1: Reference description, http://www.dublincore.org/documents/dces/
5. Denzin, N. K, Lincoln, Y. S. The SAGE handbook of qualitative research. SAGE Publications (2005)
6. Edmunds, H. The focus group research handbook, Mc-Graw Hill Professional (2000)
7. Friesen, N., Roberts, A., Fisher, S.. CanCore: Metadata for Learning Objects. Canadian Journal of Learning and Technology, vol. 28 (2002)
8. IEEE LOM. IEEE Learning Technology Standards Committee: Specifications, http://ltsc.ieee.org.
9. IMS Global Learning Consortium, http://www.imsglobal.org/
10. ISO/IEC 15938-5. Information Technology - Multimedia content description interface - Part 5 Multimedia Description Schemes (2001).
11. Melati, D., Ming, Y., Theng, Y.L., Goh, D.H., Lim, E.P. Towards a role-based metadata scheme for educational digital libraries: A case study in Singapore. Proceedings of the 7th European Conference on Research and Advanced Technology for Digital Libraries ECDL 2003, Trondheim, Norway, pp.41—51. Springer, Heidelberg (2003)
12. MPEG-7 Overview (ISO/IEC JTC1/SC29/WG11 N6828), http://www.chiariglione.org/mpeg/standards/mpeg-7/mpeg-7.htm
13. Nilsson, M., Johnston, P., Naeve, A., Powell, A. The Future of Learning Object Metadata Interoperability, 2007. In: Harman, Keith; Koohang, Alex. (orgs.) Learning Objects: standards, metadata, repositories and LCMS. Informing Science Press, Santa Rosa, California, pp. 255-313 (2007).
14. Selltiz, Wrightsman, Cook. Research methods in social relations. Holt, Rinehart and Winston, Michigan (1981)
15. UK LOM Core - UK Learning Object Metadata Core, http://metadata.cetis.ac.uk/profiles/uklomcore/uklomcore_v0p3_1204.doc