

# A set of quality metrics in learning object metadata

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**Abstract** - *The importance given to the application of methods to implement quality in e-learning leads to the need for a quality measurement. ISO/IEC 19796-3 provides a set of quality metrics that can be used for such purposes. In addition, learning objects and learning resources which are properly catalogued according to a metadata standard, includes general information about the educational resource. It is pondered the possibility of finding some elements in the LOM data model that could serve as quality metrics. Finally, some ideas for extending IEEE LOM are proposed to store more information about the quality of the resource.*

**Keywords:** E-learning, quality, metrics, metadata, standard.

## 1 Introduction

Numerous standards have been developed around e-learning in order to make progress towards interoperability and reuse of systems and educational resources [1]. Some of these standards are focused on improving quality, while some others are aimed to normalize the storage of overall information about the resource in a metadata structure. We deepen the study of these two types of standards and relate each other.

Quality can be understood in several ways. On the one hand, quality can be focused on controlling the management of a process for a teaching-learning process. On the other hand, quality can be considered as the ranking quality of resources for e-learning, such as objects or learning units.

Relevant conclusions emerged after studying the most representative quality standards related to e-learning [2]. Firstly, it was concluded that quality standards had common grounds among them, meaning quality as a quality process. In addition to that, it was observed that learning objects metadata stored relevant information related to quality management. Next step consists of studying quality as a quality of the learning resource. Metadata records of learning objects may be the most appropriate place to store quality information of the learning object.

The completeness of the metadata records of learning objects will be an essential prerequisite for the subsequent application of this study. Taking as a starting point IEEE

LOM [3], this standard provides all fields as optional. In this way, Pagés et al. [4] stressed the importance of providing information in the metadata and performed an assessment of the reality of the information available in the repositories of metadata content.

Ochoa [5] proposed metrics for ranking learning objects. He determined that the evaluation of metrics would be more optimal as these metrics were simpler. He also determined that another factor to simplify metrics consists of not using restricted vocabularies as a support to fill in textual information. In line with this, ISO/IEC 19796-3 [6] provides simple and practical metrics that serve as a starting point to identify simple quality metrics in learning objects metadata.

## 2 Quality metrics

ISO/IEC 19796 is the first international quality standard specifically developed for e-learning. It is a modular standard, which provides in its first part a framework of implementation of quality and its third party determines methods and metrics about quality, being latter grouped into four categories which in turn have different subcategories. The general descriptions of the main categories are:

*Function metrics:* These metrics are intended to measure the quality of the learning function.

*Element metrics:* These quality metrics are based on indexes obtained from the information in the evaluation of educational resource, the learning process and the actors involved.

*Attribution metrics:* Provide information on the degree of quality of the educational resource by reference to the essential characteristics of the resource, such as functionality, usability, efficiency, maintenance, etc.

*Scale metrics:* These metrics and statistical indexes are numerically measurable to provide general information about the educational resource.

It is remarkable that UNE 66181 [7] has been developed in Spain, concerning the management and measurement of quality of e-learning. This standard applies quality metrics focused on three aspects:

- Employability.
- Accessibility.
- Ease of assimilation.

### 3 Objects and learning resources metadata

Once established a comprehensive set of quality metrics, should try to have a system that ease the identification of the quality grade of an educational resource. It is proposed to this end the possibility of seeking this information in the metadata of learning objects stored in repositories of educational resources.

IEEE LOM enjoys wide acceptance and international use to classify objects, resources and learning units. Currently,

although there are other standards such as LOM and CanCore Vetadata, which are a derivative subset of IEEE LOM. Must be noted that currently ISO organization has developed ISO/IEC 19788 MLR Metadata for Learning Resources [8], which is expected to be a new reference standard due to its modular definition enhancing its compact and scalable structure, and also provides support for IEEE LOM and Dublin Core.

### 4 Quality metrics in objects and learning resources metadata

168 metrics are identified in the standard ISO/IEC 19796-3, 18 of which have been found that can be reflected in the metadata defined by IEEE LOM. Table 1 shows which data elements of the structure of IEEE LOM metadata can match ISO/IEC 19796-3 metrics for determining the quality of an e-learning resource.

**Table 1.** Quality metrics in objects and learning resources metadata.

19796-3 Category-Subcategory	19796-3 METRIC	LOM DATA ELEMENT
Attribution metrics-Reliability	Maturity	
Attribution metrics-Educational suitability	Up-to-date	2.2 Life cycle.status
Attribution metrics-Portability	Adaptability	4.1 Technical.format 4.4 Technical.requirement 4.6 Technical.other platform requirements
Scale metrics-Time	Shortest possible time	4.7 Technical.duration
Attribution metrics- Portability	Installability	4.5 Technical.installation remarks
	Fundamental navigation	5.1 Educational.interactivity type
Attribution metrics-Educational suitability	Variety	5.2 Educational.learning resource type
Attribution metrics-Functionality	Interoperability	
Attribution metrics-Educational suitability	Initiative	5.3 Educational.interactivity level
Attribution metrics-Functionality	Accuracy	
Attribution metrics-Educational suitability	Clarity	5.4 Educational.semantic density
Function metrics-Learning promotion functions	Promoting understanding	
Attribution metrics-Usability	Understandability	5.8 Educational.difficulty
Attribution metrics-Usability	Learnability	
Attribution metrics-Efficiency	Time behaviour	
Scale metrics-Period	Learning period	5.9 Educational.typical learning time
Function metrics-Learning support function	Study guidance	5.10 Educational.description
Function metrics-Learning promotion functions	Formative evaluation feedback	8.3 Annotation.description

IEEE LOM standard can be identified as the most representative existing metadata in the field of e-learning,

As an example to interpret Table 1, we can see in the first row of the table that the maturity metric is defined in the

standard 19796-3 under the category of attribution metrics, reliability subcategory. The element 2.2 Life Cycle.Status of the LOM metadata record stores information related to Maturity metric because it stores state information of the life cycle of the learning object. As a conclusion, some of the data element of LOM metadata record contains information about quality metrics as shown in Table 1.

The IEEE LOM provides in its category number 5 called "Educational use" information on educational or pedagogic characteristics of the educational resource that describes. It must be highlighted that this information should be taken into account to extract information about the quality of the educational experience. In fact, the standard itself inherently indicates a pattern on those data elements that can be taken as indexes or quality metrics. Thus, Table 1 shows the importance of "educational use" as a quality measure since it matches with 12 metrics of ISO/IEC 19796-3.

If a learning object had been cataloged with Dublin Core [9], only would have two elements related to quality metrics:

- DC.Type (type of educational resource) would report on the variety of the resource type.
- DC.Format (educational resource format) would report on the adaptability and portability of resources between systems.

It can be expected that this information provided about type and format, contributes with little informational value regarding quality indexes. Therefore, Dublin Core cannot be considered a priori an appropriate set of metadata to seek information about quality of the educational resource.

The Annotation category defined in IEEE LOM is aimed to store comments made by people who have used the educational resource, so that it may contain impressions, ratings, or suggestions for use of educational resource. These comments cannot be treated by computer since it is a text field without any restriction as to its content, but may help the end user to assess the quality of the educational resource based on the views expressed.

## 5 New quality metrics in a metadata record

In addition to those quality metrics of ISO/IEC 19796-3 found in IEEE LOM, we should not forget the existence of other standards that can complement the metadata structure with more indexes: UNE 66181 standard is the first approach to the measurement of e-learning in Spain. CWA 15661 standard [10], in which content there can be found a guide to help on decision-making to choose educational supplies, includes a proposal for general information for educational resources called LST Profile. Table 2 shows that UNE 66181 complements ISO/IEC 19796-3 with rates of employability,

**Table 2.** UNE 66181 and CWA 15661 complementing ISO/IEC 19796-3 and IEEE LOM

<b>UNE 66181</b>	<b>ISO 19796-3</b>	<b>IEEE LOM</b>
Empleability (market demand)		
Empleability (certification)		
Accesibility	X	
Ease of assimilation (interactivity)	X	X
Ease of assimilation (tutoring)	X	
<b>CWA 15661</b>		
Information on the provider		X
General information on the e-learning supply		X
Overall organisation of the e-learning supply		X
Technology		X
Information on enrolment and administration		X
Digital learning contents/resources used in the learning supply	X	X
Face to face learning on virtual classrooms events (tutoring)	X	
Collaborative learning/interaction between learners		
Learner support	X	
Assessment of the learner	X	

and CWA 15661 contains information on employability, mentoring and evaluation not covered by IEEE LOM.

According to Table 2, proposals of indexes to be included in the metadata records of educational resources that add value in a measurement of quality are: accessibility, employability, tutoring and evaluation.

The quality index of employability, tutoring and evaluation take effect when the educational resource is a compendium of: learning object with the contents and learning materials, assessment exercises on the content and tracking student training. This group represents a higher level of abstraction to a simple learning object, which on the one hand presents an improvement in providing greater integrity to the subject, but otherwise you lose granularity to facilitate reuse in another educational context.

These metrics are described in the sections below.

## 5.1 Accessibility

Karampiperis and Sampson [11] conducted a study of possible extensions to IEEE LOM in several categories. The result of their work presents new information to include in the LOM metadata record with information about accessibility. Given the metrics defined in ISO/IEC 19796-3, accessibility is a concept for measuring quality, because it defines metrics such as navigation display, screen display, consistency of appearance and icons operation, etc.

UNE 66181 also includes accessibility as a fundamental parameter to be measured to determine the quality of e-learning. For this purpose, if a learning resource is in compliance with certain levels of requirements of the UNE 139801:2003, relevant information to determine the e-learning quality will be providing.

It is feasible to include in the IEEE LOM metadata record information regarding learning object accessibility rating (referred to within the field 9.1 Purpose), so that the metadata record is presented as a place to contain implicitly information on the degree of accessibility of the resource.

## 5.2 Employability

While the accessibility and ease of assimilation metrics defined in UNE 66181 are similarly defined in ISO/IEC 19796-3, it is not the same with the metrics of employability. Hence UNE 66181 complements the set of quality metrics with two proposals: market demand of the field, as well as the obtaining certificate having completed training.

## 5.3 Tutoring

UNE 66181 includes the functions of mentoring as a factor to take into account in assessing the degree of assimilation in training, and also occurs in CWA 15661, which includes concepts of mentoring information in its proposal. IEEE LOM only includes a brief review of information related to publishers or agents of the resource, but nothing about mentoring.

## 5.4 Evaluation

The concept of assessment is considered by ISO/IEC 19796-3 as a quality metric. Likewise, CWA 15661 provides, on the profile to find educational supplies, the category "student assessment" as a proposal for metadata related to the assessment.

## 6 Conclusions

It was observed that LOM metadata record include function and attribution metrics defined in ISO/IEC 19796-3. Therefore it is possible to find useful information for measuring the quality of educational resources in the event that their metadata compliant with IEEE LOM and are appropriately completed.

It is proposed to include information on accessibility, employability, tutoring and evaluation in IEEE LOM in order to have relevant information to an assessment of quality educational resource. In particular, accessibility metric is considered as an essential to the quality measurement; IEEE LOM however does not include information of this facet, which can be a significant lack of IEEE LOM.

IEEE LOM allows the creation of application profiles to suit different socio-cultural and demographic environments. Similarly, it would be possible to enlarge IEEE LOM including quality indices. It is also desirable that the items of IEEE LOM metadata record related to quality concepts were required to be completed to increase the chances of achievement in the exploitation of educational resources metadata.

As a further line of work scheduled beyond the current analysis of quality indexes and metadata, it is planned to carry out a system of quality assessment based on a subset of metadata. Merlot content repository can be the starting point for retrieving educational resources and metadata. Although it is far from reaching a satisfactory rate of completion in the metadata, it contains a greater number of educational resources filled with metadata compared to other repositories such as Ariadne or Maricopa [12] [5].

## 7 Acknowledgements

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