

# A Study on Pedagogical Requirements for Multi-Platform Learning Objects

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**Abstract:** This study presents the development of a proposal of pedagogical requirements for multi-platform learning objects (LO). It aims at providing a debate on the importance of such pedagogical requirements in the development and construction of LOs. It also demonstrates an analysis of these requirements performed with a built learning object operating in the Web, digital TV (DTV) and cell phone

**Keywords:** Learning Objects, Pedagogical Requirements, Object Interoperability, Multi-Platform.

## 1. Introduction

Production of digital educational material as learning objects<sup>62</sup> (LO) has been a good option to present concepts and contents more dynamically and interactively in the current educational setting. The main characteristic of such resources is being self-explanatory, modulated, digital, interoperable, reusable, and able to be aggregated. As reusability becomes an increasingly more present reality in times of Web 2.0,<sup>63</sup> the establishment of minimal requirements for these objects has proven to be very important to ensure their quality.

This study is part of the OBAA Project (Agent-Based Learning Objects<sup>64</sup>), which aims at creating a standard of interactive learning objects operating in the Web, digital TV, and cell phone. The study is focused on the establishment of pedagogical requirements to build Learning Objects. Thus, it intends to establish a system of parameters that represent, explain and guide the project and development of learning

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<sup>62</sup> To Behar et al. [1], Learning Object is any digital material, such as texts, animation, videos, images, applications, individual or combined websites with educational purposes.

<sup>63</sup> It is characterized by use of services and applications through the Web, operating individually or collaboratively. It is based on the content produced by users themselves.

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objects that materialize in pedagogical practices and in teacher-student-object knowledge interactions.

To do so a discussion on the pedagogical models for distance learning was held with the aim of conducting a parallel study on the pedagogical requirements for LO construction/analysis. In the second stage, existing standards for their development were investigated. Afterward, cards of minimal requirements for interoperable LOs were created.<sup>65</sup> Use of cards facilitates visualization and use of these requirements by anyone developing an object. For its validation an analysis table was built based on the pedagogical requirements. Finally, a pilot study was carried out based on this table with an interoperable LO in three platforms: Web, digital TV, and cell phone.

## 2. Learning Object Standards: Current Scenario

Studies on the main existing standards in the international scenario were performed in search of a requirement standard for the pedagogical model of interoperable LOs. Among the standards searched were SCORM, IMS-LD, LOM (meta-data standard), IEEE P1484, and W3C (accessibility requirements). The search was for common elements in these standards, making comparisons with the aim to decide which best meets the needs for the development of pedagogical requirements for an LO.

The IMS-LD (Learning Design), according to Dutra, Tarouco [2], is a modeling language to define learning objects and activities specified by IMS based on the EML (Educational Modeling Language), which allows describing pedagogical models that are advanced, reusable, collaborative, multi-actor, and with personalized teaching routes.

The SCORM standard consists of a reference model, that is a unified set of specifications to make e-learning contents and services available [2].

The LOM specifies syntax and semantics, allowing for a catalogue of teaching materials (meta-data), grouping useful data in a standardized format. It aims at ensuring efficient identification, (re)use, management, interoperability, sharing, integration, and retrieval.

This study used the LOM because it is the most complete and widely used. In the educational area meta-data are used to describe LO, i.e., resources can be reused by several environments, allowing presentation and fast retrieval according to the needs of the educational context. In addition to facilitating object sharing and exchange, use of this standard allows for the development of catalogues, while considering the diversity of cultures and languages in which learning objects and their meta-data will be explored.

In these specifications there were similarities between some elements present in both SCORM and IMS-LD. Therefore, because the IEEE LTSC P1484 met the needs, it was chosen to guide the definition of pedagogical requirements. Objectively, it can be said that the IMS-LD standard uses meta-data elements found in the LOM, writing it in XML, and the SCORM adopts the description in XML from the IMS (called

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<sup>65</sup> Interoperable LOs are designed to be used in different platforms; in this case, digital TV (DTV), mobile devices (cell phones) or Web.

Meta-Data XML Binding). However, in the IEEE LTSC P1484 it was possible to find the same elements, better elaborated and more complete.

It is worth stressing that, although such standards have educational specifications, none of them presented minimal pedagogical requirements for LOs. In this context the necessary theoretical framework regarding objects was searched for in the current literature.

### **3. Pedagogical Requirements for Objects: Searching for a Theoretical Background**

The development of learning objects has characteristics that, among other factors, depend on educational objectives, pedagogical methodology and strategies, on the content that will be approached and on the technological possibilities for their implementation. There is an increasing demand for educational material that accounts for this new context. It demands the participation of professionals with a quite open, preferentially interdisciplinary formation and that are able to move freely across knowledge areas implied in the development of learning objects.

According to Silva & Fernandez [3], building, developing, and using this type of material, from an interactionist perspective, is valuing action, critical thinking, curiosity, demanding questions, restlessness, and uncertainty. Therefore, it is possible to enhance the potential of teaching and learning processes, divergent thinking, confrontation, analysis, ability to compose and recompose data and argumentation, which requires a teacher that encourages doubt. Hence, action becomes an exchange instrument, building knowledge through action schemes and coordination [4]. In this line of thinking, organizational, content, methodological and technological aspects of learning objects (LO) were defined to form a pedagogical model.

Among organizational aspects the types of team (disciplinary, multidisciplinary and interdisciplinary) to build objects, definition of educational objects and types of browsing an LO were investigated.

Aspects relative to content were defined based on Zabala [5], namely, (1) Factual Contents – regarding learning of facts through more or less literal copying activities, such as repetition exercises; (2) Conceptual Contents, which allow for recognition of previous knowledge, assuring significance and functionality that are adequate to the development level; (3) Procedural Contents concern the need of performing sufficient and progressive exercises of the different actions forming procedures, techniques or strategies; finally, (4) Attitudinal Contents, which have a conceptual nature of values, norms and attitudes. These elements have a direct influence on teaching strategies, which were studied to define pedagogical requirements (see item 4).

Most frequent types of activity, types of interaction/interactivity and evaluation were investigated in terms of the methodological aspects of LOs. In an interactionist epistemological background, it is believed that the individual knows the world by interacting with knowledge objects, whether they are situations, animals, objects and/or other individuals. Thus, such requirements may indicate learning situations in which the educational paradigm of LO can be developed. Their importance lies in the possibility of opening new forms of using an object according to the user's learning

style and the teacher's epistemology. Hence, it can be stated that the definition of minimal pedagogical requirements can subsidize construction of LOs that are more open to different pedagogical practices.

#### 4. Proposal of Pedagogical Requirements for Multi-Platform Learning Objects

Based on the existing studies on such standards, pedagogical requirements were defined using cards, as shown in figure 1. Each card has a description of the requirement, as well as a pedagogical justification of its importance and reference. There are 46 cards, divided into six categories, which are used to define which elements may be present in an interoperable LO. Next, the categories are also described.

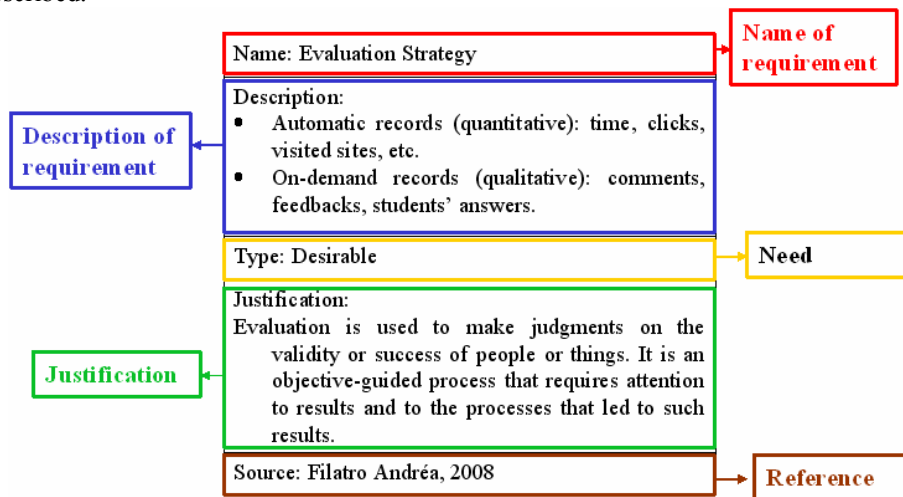


Figure 1: Card of pedagogical requirements

##### 4.1 Identification/Meta-data

These requirements aim at identifying LOs for further cataloguing of the learning object. This category should contain enough information, so that the user identifies whether or not the LO is relevant for him. Thus, users can search it according to their interest. Minimal requirements for meta-data are subdivided into five subcategories, based on the definitions for meta-data in standard P1484:

1. General - groups general information describing the object.
2. Life cycle - gathers items describing the characteristics related to the history and current status of objects.
3. Technique - illustrates minimal technological requirements for using the object in a given platform.
4. Educational - describes educational, didactic and pedagogical characteristics of LO.

5. Licensing - clarifies the rights of use and reuse of LOs, as well as the terms of intellectual property.

#### **4.2 Technological**

Technological requirements set the minimal and maximal parameters relative to the media used in the learning object. Resources are optional in the LO as they concern didactic tools and methods. However, this parameter is considered mandatory due to its importance for good object usability. Parameters were established based on studies on interaction design [6] and content organization [5].

#### **4.3 Educational**

The educational category deals with the requirements regarding didactic strategies, types of content, strategies of collaboration/cooperation and evaluation. According to Zabala [5], there are four types of contents, which may be used by teachers as they wish. Interactions concern people's behavior toward other people and systems. It is possible to provide significant learning experience if the designed educational solution is, above all, interactive. This means providing an interface that demands students' interaction with contents, tools and other people. Finally, evaluation is used to judge the validity or success of people or things. It is an objective-guided process and required attention to results and processes.

#### **4.4 Communication object content and Data Auxiliary**

These requirement categories refer to the possibilities of using LO in association with Virtual Learning Environments (VLEs). Such parameters were based on the SCORM standard, which sets norms to the encapsulation of LOs for integration in VLEs and in the P1484 standard, which develops a framework of LO creation. Therefore, they provide independence of VLEs in which LOs will be used, facilitating migration between them, as long as they are compatible with this model.

#### **4.5 Accessibility**

Based on the recommendation of W3C regarding accessibility, this category defines parameters so that LOs can be accessible by any user in any platform. Such recommendations suggest content adaptations according to the need of those using the LO.

In such a fragmented market as that of devices and browsers, standards are the best guarantee of interoperability. Predicting support to many devices will result in a higher number of product users. Thus, it is important that tools have a support for Assistive Technologies since it facilitates interaction of users with special needs.

## 5. Pilot Project: Validation of Requirements for Analysis of a Multiplatform LO

After definition of requirements, an analysis table of LOs was developed based on cards for methodology validation. The table was used in the evaluation of learning objects. It includes the name of the requirement, its subdivision and a description.

Using this table for evaluation required an adaptation of an LO so that it could be executed in three different platforms (digital TV, cell phone and Web) because an object that met the needs of this study was not found. The LO “Other Childhoods,” developed by the Center of Digital Technology Applied to Education (NUTED/UFRGS), was chosen to perform this adaptation because it has an open source code, facilitating its modification/inclusion. There was the need of adapting the LO, both visually and in terms of content, so that it was possible to meet the highest number of requirements in interoperability. Changes were mainly in layout, text organization and activities, which had to be reformulated. The colors were programmed to change automatically according to the platform, with the aim of meeting usability requirements. Figures 3, 4 and 5 present the adapted LO.

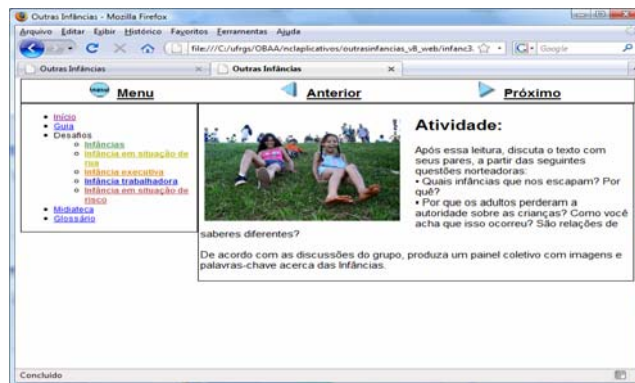


Figure 3: Interoperable Web LO.

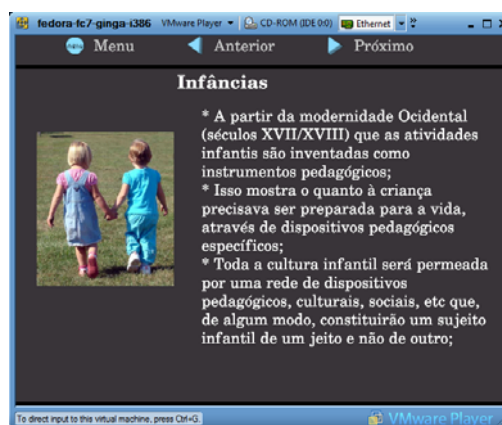


Figure 4: Interoperable DTV LO.



Figure 5: Interoperable Cell Phone LO

This first LO evaluation was a pilot project, aiming to analyze whether the requirements proposed could be supported by available technologies. An evaluation was performed to verify whether the table provided all the indicators for analysis of a multiplatform LO; therefore, it was possible to propose new pedagogical requirements based on what was empirically observed.

## 6. Final Considerations

Evaluation of LOs based on requirements allowed for analysis of the possibilities each platform has of meeting the initial proposal. The next step is to build and apply a multiplatform LO in an extension course at UFRGS to investigate how users interact with LOs in DTV, Web and cell phone.

Afterward, scenarios to apply such multiplatform LOs will be studied to define the types of users and their cases of use. Therefore, the intention is to develop objects that are increasingly closer to users' needs.

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