

LEARNING OBJECT MANAGEMENT FOR IT-ILLITERATE INSTRUCTORS

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Abstract

The ever-increasing presence of e-learning tools in education at different levels has brought about a wealth of electronic teaching material, often convertible into *Learning Objects* (LOs). However, in spite of the advantages of the LO model and the technology associated with it, there is a gap between the IT knowledge and skills of the potential users of LO, i.e. the instructors, and the potential offered by the LO approach. Showing an example of academic R&D put to the service of education, this paper presents a novel procedure for the transparent creation of LOs which can then be stored and managed in LO repositories. This procedure uses a tool for quality assessment to guide the construction process of LOs.

Keywords: Learning Objects, Learning Object building, quality evaluation, Learning Object repository.

1 INTRODUCTION

The field of digital learning is a thriving one, as attested by the vast amount of digital learning products continually appearing in the market, as well as by the wealth of conferences (e.g. EDULEARN) and publications devoted to it, including about a dozen or so journals. The fact is, however, that, as pointed out by Lakkala and Paavola, “the development of digital learning materials and their usage is active and continuous in practice, but there may not be much research about it” [1]. The dearth of empirical research on the subject, as these authors conclude, has a negative effect in the effectiveness of the use of the existing materials. This is something that specifically affects the kind of digital learning materials addressed in our paper: Learning Objects (henceforth LOs). The bibliography concerning LOs is also for the most part devoted to the presentation of LO management software, e.g. [2] [3] [4] [5] [6], to mention but some of the most recent publications, or the discussion of several theoretical issues, e.g. [7] [8] [9] [10] [11], without really attempting to look into the actual use that instructors make of those materials, and the eventual difficulties those instructors run into – and, most importantly, why they experience those difficulties – when creating LOs and managing these within LO repositories (henceforth LORs).

There are two main ways in which researchers tackle the quest for the efficient creation and use of LOs by instructors: one of them is the development of guides for the creation of LOs [12]; the other is the creation of devices such as templates and toolkits to guide instructors in the design of new LOs, e.g. [13] [14]. In spite of the unquestionable help that these resources represent, there are limitations associated with both of them. LO creation guides are often hard to handle for IT-illiterate users and are usually address at content developers; therefore they do not have the intended impact on quality. The use of templates and toolkits, in turn, though providing a clear guidance to instructors who might otherwise feel at a loss, does not solve a inherent problem of LORs, i.e. metadata standard models are too rigid and complex, and therefore difficult to adapt to the descriptive needs of the LOs added by different users. Additionally, there are also quality evaluation models available for instructors [15] [16], but the same as LO creation guides, they are not always easy to understand or apply.

Besides the efficiency issue, the creation of LOs must always take into account the ulterior quality evaluation. This evaluation is only part of the general goal of ensuring quality education, but from the point of view of teachers and students, it is crucial to have models and guidelines for the assessment of the quality of teaching materials. For the instructor, it means being able to be given credit for an activity that requires great dedication and that, until now, was not sufficiently recognized. For students, having good teaching materials ensures a more effective learning. However, there are few universities and/or quality accreditation agencies that have quality models or guidelines, and that apply them. At

an international level, we should highlight the Norwegian model DESIRE [17], the quality system of MERLOT, an international LOR [18] and the LORI (Learning Object Review Instrument) quality tool [19], which is used in a good number of Universities. Current efforts are being made at European level, such as MASSIVE and UNIQUe. In Spain, as attested by the results of the survey carried out by REBIUN [20], there is a lack of repositories exclusively devoted to digital teaching resources. Likewise, there is also a dearth of guidelines for the creation of quality LOs. Guidelines have been found only for the creation of educational texts, e.g. University of Murcia [21] and the UNED [22], or quality virtual learning environments, e.g. UCM Virtual Campus Quality Guidelines [23]. In all these cases, the application of quality evaluation models, are always a posteriori and by external evaluators, which is often confusing and discouraging for instructors at the time of entering new LOs – see [7] about the poor agreement between users and experts concerning the quality of LOs.

The most widespread situation faced by instructors when approaching LORs is highly conditioned by the above-stated problems. What they usually find is that the management of learning materials, using IT tools, has to be done by the users themselves, without assistance or with little help; with no or low technology resources (staff, hardware, software); with no or little recognition; and with a great effort and limited availability of time, as it is extra-work. All this is accentuated by the fact that the IT prowess of many instructors, mostly in the area of Humanities, is well below the demands of LOR management. As a result, a majority of faculty members – at least within the context best known to us, i.e. tertiary education in the Humanities – fail to create quality educational materials or to maintain and improve them. Others create materials with great pedagogic potential but which are technologically poor (i.e. they are non-interoperable, difficult to use, difficult to upgrade, not documented, structurally unclear, etc.). All this also results in little use of these materials and/or the teaching-learning environments involving the use of computers or communication tools (virtual campus, language labs, etc.). The ultimate consequence is that students are no longer encouraged to use IT and communication tools to study and work, with the corresponding impoverishment of their education.

Our research and teaching experience in Teaching Technology and e-learning has shown us countless examples of digital teaching materials of great educational value that have required a significant investment in time and money, but have hardly been used because of their excessive dependence on technology support or because they include content which may eventually expire. In this regard, the authors of this paper have been involved in the development of new systems, models and methods of teaching and learning in Web environments that enable teachers to create, use and disseminate educational or research digital materials [24] [25] [26] [27].

This article describes some of the most recent work we are carrying out: the design and testing of a procedure for the transparent creation of quality LO libraries. The paper is organized as follows. Section 2 states the research question guiding our research; section 3 introduces the conceptual framework underlying the LO creation procedure; section 4 summarizes the LO quality tool, called COdA, developed to carry out the procedure; section 5 presents the procedure and its experimental evaluation in the School of Language, Linguistics and Literature ('Facultad de Filología') at the UCM; section 6 outlines our findings to date and offers some pointers to the future.

2 THE RESEARCH QUESTION

The research question driving our research is how to create LOs in an efficient and transparent way while at the same time ensuring their quality. By 'efficiently' we mean that authors do not need to invest more effort than they normally invest in the creation of digital teaching materials, but the result is a LO reusable in different ICT-related teaching contexts that expands the possibilities of use without increasing the cost (in terms of time, effort and material resources) of creation. By 'transparently' we mean that authors do not need any prior knowledge about LOs, or be computer experts. Finally, we consider that a LO is a quality one if it is effective for teaching and/or learning, reusable and accessible.

In this paper we present a proposal based on the application of a quality evaluation tool developed to induce the transformation of educational materials into effective and accessible LOs.

3 QUALITY LEARNING OBJECTS

The concept of learning object appears in the field of Educational Technology and the related industry with an aim to reduce costs in the production of digital didactic materials or resources [28]. A LO is any digital resource for instructional purposes that can be reused in multiple disciplinary, educational and

IT contexts. The goal is to create educational materials as pieces that can be assembled together to create more complex ones and added to any e-learning computer system for use [29]. This increases the profitability of these objects.

The idea of improving the profitability of digital materials at industrial level can also be applied to the case of instructors. If these build their teaching materials so that they are as reusable, accessible and independent as possible of the technology, they will then be able to use them in new disciplinary and IT contexts as well as to build new materials. However, the theoretical and technological knowledge needed to build LOs is beyond the reach of many faculty members, at least without the support of IT technical staff.

One possible way to address the construction of LOs without theoretical knowledge or expertise on these is by including, during the construction of digital learning materials, an assessment of their quality. This type of evaluation, called 'Process evaluations', "...formatively assess the planning, design, development, and implementation of learning objects and associated efforts to use them, including attempts to adapt instruction based on individual differences as expressed in learner profiles, etc" [30]. Thus, if an evaluation tool is applied which is conveniently designed to assess the criteria that make LOs profitable, the task of creating digital teaching materials can be oriented towards the creation of LOs.

There is, however, no consensus regarding the concept of quality applied to teaching materials [31]. Our research has looked at this problem and offers a possible interpretation, close to both the needs of Spanish faculty members and the industrial objective of profitability that originated the LOs. A LO is considered a quality one if it is profitable academically. We understand that it is profitable academically if it 1) helps the instructors and students to learn more in less time and 2) is used frequently – because it is reusable, interoperable, durable and expandable. In short, we believe that the improvement of academic profitability entails an improvement in the quality of LOs.

To sum up, for the teacher to build transparent LOs, a quality evaluation tool is needed which is both easy to implement and allows users to systematically turn original didactic teaching materials into quality LOs (QLOs).

4 THE LO QUALITY EVALUATION TOOL

The quality tool for the evaluation of educational materials developed in this research work has been called COdA (*Calidad y Objetos de Aprendizaje* ['Quality and Learning Objects']) and is based on the Learning Object Review Instrument (LORI) [19]. LORI is a model widely used, with support software tools and reliability studies [32]. However, LORI was not adequate to guide faculty in the adaptation of teaching materials to LOs because 1) it is a tool for the evaluation of materials that are already LOs, 2) LORI has a broad scope – any teaching level, national or international – which does not help guide instructors in building LOs specifically aimed at tertiary education, and 3) its use requires extensive computer skills that instructors usually do not have. That was the motivation for developing COdA, which builds on LORI to help teachers create digital teaching materials by prioritizing the criteria relating to academic profitability in higher education. These criteria are: 1) effectiveness to teach future specialists, 2) reusability, including interoperability, durability and extensibility, and 3), accessibility to all users, even if they have a disability.

More precisely, the adaptation of this tool basically consisted in: 1) softening the interoperability requirements of LOs – by allowing contents conforming to de facto standards which are easier for teachers to meet than official standards, 2) including basic accessibility recommendations from W3C and the IMS Global Learning Consortium for the creation of web content and digital educational content [33]; and 3), including quality evaluation models developed in Spanish Universities, notably the UNED [22], UCM Virtual Campus [23] and the University of Murcia [21] .

The result is a tool which, like LORI, consists of a questionnaire for the evaluation of ten quality criteria and a manual with instructions to help complete the questionnaire [34]. With this evaluation tool, both the author and the users as well as the potential external reviewers can evaluate digital learning materials by rating them according to ten criteria:

- 1) Teaching goals and coherence
- 2) Clarity of contents

- 3) Reflexivity, interactivity and innovation
- 4) Feedback
- 5) Motivation
- 6) Layout and Design
- 7) Usability
- 8) Accessibility
- 9) Reusability
- 10) Interoperability

Criteria 1 to 6 assess the efficiency of teaching; criteria 7 and 8, accessibility; and 9 and 10, reusability. To facilitate its implementation, the tool, like LORI, seeks to provide clear and concise information about each of the criteria evaluated, providing real examples of LOs as well as a detailed evaluation model which allows rating each one of the 10 criteria from 1 to 5.

COdA is currently being evaluated by teachers who have used it to create their LOs. To do this, we have made a second questionnaire consisting of 9 items to be rated from 1 to 5, plus 2 questions. The nine items are:

- (1) It is recommended to evaluate the LOs before their inclusion in the repository.
- (2) The results of the LO self-assessment should appear in the metadata record.
- (3) The LOs must undergo peer review before being included in the repository.
- (4) The results of the peer review of the LOs should appear in the metadata record.
- (5) The instructions given in the guide are clear enough.
- (6) The guide is useful; instructions are relevant and facilitate the application of the criteria.
- (7) The evaluation criteria set out in the guide are easy to apply.
- (8) The criteria are sufficiently clear, and can be easily understood.
- (9) The evaluation criteria are useful because they help improve the quality of LOs.
- (10) (10.1) Are there any redundant or unnecessary criteria to evaluate your LO? Why?,
- (10.2) Do you miss any criteria? What is it? Why?

5 SYSTEMATIC CREATION OF QUALITY LEARNING OBJECT COLLECTIONS

The procedure for the systematic creation of quality LO collections (QLO building procedure) consists of four steps:

- 1) Creation. Faculty members or teams create or digitize their teaching materials in the usual manner.
- 2) Evaluation. They evaluate the quality of the materials they themselves have created or are creating, by means of COdA. Once the material is evaluated, one can go on to step 3 or stop if the evaluation has been satisfactory
- 3) Fine-tuning. If the evaluation proves that the material fails to meet one or more criteria, the material is modified so as to obtain a higher score. Normally, after adjusting the material the instructor returns to step 2 to re-evaluate the new version.
- 4) Storage and Documentation. The instructor stores the LO in the repository. This involves the description of the LO according to the metadata record of the collection. At this time, if the evaluation is satisfactory, the instructor can be said to have created a quality LO.

5.1 Experimentation at UCM

To test the feasibility and efficacy of the quality LO creation procedure, a Project for Educational Innovation and Improvement of Quality Teaching (PIMCD) has been undertaken at the Facultad de Filología (School of Language, Linguistics and Literature), UCM, for the creation of a LOR. The project is currently in its final stage of collection and analysis of results.

5.1.1 Participants

The project participants are faculty from different fields in our School (English, Spanish, French, German, Arabic, Danish, Italian, Portuguese, Bulgarian, Bibliography and Linguistics) and the School IT Technicians. Participants have been organized into three working groups:

1. Teaching Resources Team (TRT), responsible for the creation, documentation and pedagogic application of digitalized teaching resources in different languages and areas of expertise, following the QLO building procedure. They are also responsible for evaluating the guidelines developed by the Modelling Team (see below). It is a large and multifarious team, so as to ensure that the Quality LO procedure is applicable regardless of the variety and quantity of the educational resources and the instructors' IT-skills. In addition, this team values and assesses the feasibility of the quality guidelines and the documentation model proposed by the modelling team. Only one of the team members has advanced IT skills; two of them have average IT skills; the other seventeen have low to intermediate IT skills. None of the members has previous LO expertise.
2. Modelling Team (MT), responsible for developing the quality guidelines tool (COdA); and also in charge of inducing the general descriptive model of teaching resources prepared by the TRT. This model is used and validated by the TRT when documenting teaching resources. All group members have low to intermediate IT skills. None of the members has previous LO expertise.
3. Technical Team (TT), responsible for providing the necessary support to use the LO repository, advising the other teams on technical matters and training the School technicians in the maintenance of the repository (backup and possible failures). None of the members has previous LO expertise.

5.1.2 Methodology

The methodology followed to carry out the experiment has been the following:

Phase 1. Preparation of a quality evaluation tool draft by the MT.

Phase 2. a) Preparation of a first sample of digital teaching materials and validation of quality guidelines by the TRT, with the support of the TT if necessary; b) preparation of the second sample of digital teaching materials – if necessary – and further validation of the quality guidelines COdA. Although the procedure should be implemented during the construction of teaching materials, the availability of two samples before and after the application of COdA allows comparing the effectiveness of both COdA and the procedure. By the end of this phase, the existing version of the COdA tool was considered to be final.

Phase 3. Writing up the documentation and classification of materials by the MT, done inductively. The first sample of materials was used to extract the documentation model and the second sample served to confirm, supplement and correct the model. The data model changed during the use of the repository, but having a simple initial model helped the instructors to complete the LO metadata. By the end of this stage, the existing version of the basic documentation model was considered to be final.

Phase 4. Once the model was established, the team documented and stored teaching materials in the repository. By the end of this phase the preparation of the Schools of Language, Linguistics and Literature's first LO library, was considered to be complete.

5.2 First results

At the time of writing, the project of creating a QLO library is at the end of the second phase – evaluation of COdA – and ending the fourth phase – storing QLOs. Although experimentation is not over, it is possible to offer some significant results on the feasibility of the construction of QLOs:

- 1) An initial reference collection of 28 QLOs has been created from 33 materials on paper or digitized and with a high educational value but which initially had serious technological deficiencies, such as high dependence on hardware or software and little or no accessibility.
- 2) Out of 33 self-evaluated LOs, 12 of them do not meet the reflexivity criterion, 5 do not meet the reusability criterion and 3 do not meet the accessibility and retroactivity criteria. Considering that reflexivity is an educational criterion of descriptive, rather than prescriptive, nature, we can claim that only 5 of the 33 initial materials do not meet the basic requirements of reusability and accessibility to be met by QLOs. The result is that around 84% of the

teaching materials that have been built according to the QLO building procedure can actually be considered QLOs.

- 3) A tool for evaluating LO quality has been developed to guide users with little IT knowledge and resources in the creation of quality educational materials. We have evaluated its feasibility and efficiency and the results have been the following:
 - a. Instructors unanimously recommend using it to self-evaluate one's digital teaching materials. They also consider it advisable to publish the results of the self-evaluation with respect to accessibility and reusability criteria so as to guide other users on the usability of the material.
 - b. Some reluctance, however, has been observed towards the inclusion, in the metadata record that accompanies the repository LOs, of the results concerning the rest of the criteria for self-evaluation and peer evaluation.
 - c. More than half of the teachers surveyed indicated, without being questioned, that they modified their materials during the self-evaluation process so as to meet the COdA criteria, particularly with regard to reusability, independence and modularity of the LO.
 - d. Regarding the usability of COdA, the results are not entirely satisfactory. Although most users (16 out of 18) give usability a good score (3 to 5 out of 5), more technical criteria, such as accessibility and interoperability, are considered not easy to apply. It is also worth highlighting some suggestions about the need to include criteria ensuring the respect for the intellectual property of reused materials.
- 4) Finally, and in addition to the LO library, an empirical and dynamic model of metadata for LOs has been generated within the field of Language, Linguistics and Literature. This model has evolved together with the library and will probably continue to change as new LOs are added. Instructors consider that having a metadata record for each LO is really useful.

As an illustration of how our model shapes the work of instructors, and the feedback given by these, in 5.3 we reproduce the report made by a faculty member highly involved in the creation of LOs and the management of OdA and COdA.

5.3 LO implementation: a war story

The introduction of new technologies provides a golden opportunity for the teaching of phonetics, for example. In contrast with our University tradition of placing focus on the IPA-transcription of *written* texts, merely following prescriptive standards of pronunciation, we find it essential to expose students to real audio recordings whereby their auditory skills can be trained and improved. The same is also true of a related field, namely, the correction of pronunciation to students of a foreign language. However, only very recently has the importance of this subdiscipline been acknowledged, and this lack of attention has obviously led to a scarce development of audiovisual material that may possibly support this activity.

Thus, instructors have to become their own material designers, but the creation thereof demands a major investment of time, and on many occasions with limited knowledge of the required technology and none or little aid. The absence of an overt trend of creators to lean on one another does not help, either. On the other hand, younger generations of teachers have designed their materials as digitized from scratch, but other colleagues, who have invaluable yet analogical teaching resources, are reluctant to adapt their materials to new methodologies, inasmuch as their effort is not sufficiently appreciated.

The first group of students who took our Spanish as a Foreign Language (SFL) courses right after the launch of our state-of-the-art, digital language laboratories benefitted from a greater teaching / learning efficiency. The oral skills class succeeded, indeed, in fostering the oral comprehension and expression competences while facilitating the correction of pronunciation in an integrated and natural way. However, dependence on audiovisual technology made it difficult for students to keep practising at home, compared to other aspects of language learning, such as writing, reading, or the study of grammar and vocabulary.

It was then necessary to implement an extension of the language lab through our e-learning platform (*Virtual Campus*). As explained in [26], additional audio- and video-files were hosted in *Virtual Campus*

so that students could further practise oral comprehension. Moreover, a digital audio recorder was integrated in the platform to allow the learners complete extra pronunciation exercises. Their productions were accessible thenceforth, thus making it possible to keep track of one's own progress.

It goes without saying that this prolongation of the class beyond the classroom demands a greater commitment to developing additional teaching resources and materials. Nevertheless, the necessary underlying research, as well as the time and effort invested in this, are not generally acknowledged.

Following these considerations, I find it encouraging to participate in such a project as the creation of a digital repository of LOs. Having experienced in first person the acute shortage of readily available materials, and the need to design my own in record time, it merely motivates me to make a contribution of this kind so that others do not have to waste time repeating something that is already done, but can devote themselves to conceiving new materials to fill other gaps. Furthermore, it is clear that, in the same vein as us, other professors also generate resources. However, unless they are shared in a well-documented manner so that they can be easily retrieved, their existence will remain unknown and of little use for the rest. It is therefore highly desirable to stimulate a synergy to share one's own materials, but it is equally important to provide a user-friendly platform where we can share them, and also where we can find what we are looking for.

Now, to maximize its usefulness, the shared object has to meet certain requirements. In this project, and in order to evaluate the degree of fulfilment of those requirements, the COdA tool was developed and authors were advised to make an evaluation of their own LOs. According to my experience, this assessment is fairly beneficial, since in more than one occasion the realization that some minor changes to the LO could raise the punctuation of some criteria lead to an improvement of the final product. No matter whether it is the incorporation of a template to grade an exercise and thus give feedback to the student, or a clearer statement of the didactic goals, the need of auto-evaluation helps us authors detect potential improvements needed by our LOs.

Not all the criteria were as easily applicable as others. For instance, more often than not the specification of accessibility was simply not suitable for audiovisual objects targeted at auditory perception tasks, as those mentioned to be used in the phonetics class. Yet the very indication of this fact in the metadata can be a desirable feature, in order to appraise potential users. On the other hand, the presentation and design criterion somehow overlaps with the definitions of motivation and usability. The positive side of having realized that, based on the authors' impressions, is that the criteria can be redefined in more detail, thus increasing the flexibility and user-friendliness of the COdA tool.

Another point that may not be intuitive to the lay user of the repository is the very concept of *learning object*, as opposed to a more traditional *teaching material*. I myself found it a merely terminological difference at first (and, I must admit, also to some extent now). However, I have learnt something about it; something about the reusability criterion that will hopefully add to the quality of my LOs. It is obvious that, when I create a new LO, I conceive it as a whole. And I assume that, in a second stage, another instructor who wants to use it may also want to add new parts and thus complete it. Interestingly, though, the opposite may also be true, namely that the other professor only needs a specific subpart of the original content. For this reason, and even though a LO can have whatever dimension its author wants, it is advisable to split it into smaller meaningful units, and then define the global LO as a combination thereof.

The application of all these considerations will surely make OdA a more valuable tool, inasmuch as its user-friendliness will encourage authors to share high quality resources to fill the current gap with, and, on the other hand, it will make it easier to retrieve those LOs in a practical, customized fashion.

6 CONCLUSIONS AND FUTURE WORK

Creating quality LOs is currently a need and a problem for IT-illiterate faculty in higher education. One way of addressing the problem is to include, in the usual procedure for creating digital learning materials, of quality self-evaluation procedure guiding the creative process towards the generation of academically profitable and technologically feasible LOs.

Compared to other approaches, our proposal provides a solution accessible to any instructor or team of instructors with limited computer knowledge as well as human and technological support. The experimental results are satisfactory to the extent that 1) the feasibility of the procedure has been proven by means of a realistic project to build a LO library in a non-technological field such as that of

Language, Linguistics and Literature; and 2) the procedure has succeeded in improving the quality of teaching materials in both the pedagogical and technological aspects.

It is not possible, however, to ensure that by applying this approach 100% of the materials in a collection created by a group of teachers will be QLOs, since, as shown by the first experimental results, the success (84% in our case) depends on 1) the degree of involvement of instructors in improving the quality of their materials; 2) having some sort of technical support so as to know how to apply IT quality criteria such as accessibility and interoperability.

The use of an objective tool for the self-evaluation of quality during the construction process of digital teaching materials: 1) helps to improve these materials both from a pedagogic and a technological point of view; 2) helps teachers to understand the concepts of reusability, accessibility and technological independence and how to apply them; and 3) encourages the habit of sharing teaching materials, something not very frequent among instructors in Spanish universities. In this regard, we suggest that the institutions and committees working on the quality of education, consider and value quality self-evaluation as a further indication of quality, very economical and with an important positive effect on the quality of teaching.

Pending tasks are, firstly, the revision and adjustment of COdA to improve its usability and, secondly, the study of the use (and reuse) of LO libraries in the new electronic learning environments in non-technological fields of knowledge. In this sense, we will test the integration of the LO repository OdA into the UCM Virtual Campus with the aim of using it in virtual sessions, in the classroom or in the language lab. If IT-illiterate faculty incorporate LOs both into their classroom and virtual teaching in a natural way, and if the LOR keeps growing by the addition of new LO collections, then COdA and the QLO creation procedure will have proven their usefulness in the creation, use and dissemination of new digital research and teaching materials in non-technological domains.

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