

A proposal for benchmarking learning objects

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Summary

This article proposes a methodology for benchmarking learning objects. It aims to deal with two problems related to e-learning: the validation of learning using this method and the return on investment of the process of development and use: effectiveness and efficiency.

This paper describes a proposal for evaluating learning objects (LOs) through benchmarking, based on the Learning Object Metadata Standard and on an adaptation of the main tools of the BENVIC project. The Benchmarking of Learning Objects (bLO) method aims to contemplate the properties of LOs, their application and stakeholders, and proposes procedures and tools for evaluating LOs. This method does not intend to be a definite or closed system. It defines a working baseline for evaluating LOs, the first step for creating a more complex and more reliable evaluation system that is constantly improving.

The paper introduces the guiding principles of the bLO system that provided the guidelines for the development of the tools. This system includes three main tools, two of which were fully developed, and a complement to improve the applicability of the method. It includes a profiling tool based on the LOM, the benchmarking indicator system, and proposes a competence map as a mechanism for continuous improvement. Additionally, a weighting system for efficiency and effectiveness was developed as a complement to the indicators matrix.

The bLO was applied in two different contexts. To test the applicability of this method, three modules on a Master Course in Construction were used. The information provided by this test was important to improve the tools, in particular the indicators system. Later, the bLO method was used as an evaluation tool for some of the outcomes of the European Project entitled "E3: Electronically Enhanced Education in Engineering". This project aimed to develop LOs that were exchanged and evaluated among the international partners.

Finally, the paper introduces several areas for future work, aiming at improving the system and integrating it with other systems.

Keywords

Evaluation, learning objects, reusability, quality

1 Introduction

The use of Information and Communication Technologies (ICT) in Education has been increasing during the last decade. It has been evolving and facing new and rapid developments. However, producing electronic high quality learning materials is a slow and expensive process. Up to now, e-learning has not been proven to be an efficient solution for Training and Education, in terms of return on investment (ROI). It becomes urgent to create mechanisms to evaluate e-learning and make it more competitive so it can be widely use. This necessity led to the development of a new Learning Technology, the Learning Objects (LO), modular learning materials that can be combined with other LOs to produce more complex learning materials or can be taken apart and recombined to create new LOs. The LOs concept aims to increase the reusability of the Learning Materials, increasing at the same time the efficiency of the process.

Besides the economic perspective, there is another motivation to evaluate the use of e-Learning and it is related with its effectiveness. The Teaching and Learning process is very complex, and it is not easy to evaluate its quality [2]. When introducing a technology within this process, the complexity increases and, as a consequence, evaluation can become more difficult. The use of e-Learning has been increasing dramatically, however its use has not been validated as an effective way of Teaching and Learning.

When evaluating LOs, a recent concept, immature, with no consistent history of utilization or evaluation, the process of defining evaluation criteria becomes very hard. The reuse potential of LOs only brings more complexity to the process, because they can be used in different contexts and Education is intrinsically dependent of context.

This work proposes a dynamic and flexible method to evaluate the efficiency and effectiveness of LOs, in a framework of great instability and constant change. After analyzing the present framework for e-learning and evaluation of Education, the LO concept, features and models, a benchmarking system for evaluating LOs is proposed, based on a collaborative approach that can answer to the concrete needs of the present day but that will rapidly adapt to the changes, in a process of continuous improvement.

2 The LO Concept and Reusability

The application of the Information and Communication Technologies to Education and the Internet in particular, can result in deep changes as has been happening in different areas. As this change occurs, the learning materials currently in use will probably become more and more inadequate and will have to adapt to the new needs and contexts of the new Information Society, regarding contents, media, deployment, etc [1].

Electronic learning materials have been used for a long time. However, when mass usage is intended, new problems arise, regarding the efficiency and effectiveness of the whole process. Tools should be available to allow stakeholders to do an informed choice of the materials to use. The LO concept that promotes the reusability of learning materials intends to provide a solution mainly to the problem of efficiency. Modular learning materials can be reused in different contexts, as long they are properly catalogued. However, cataloguing LOs is not an easy task, because they are not only content and technology, but also include pedagogical principles and methods.

As a basis for this work, the LOs definitions proposed by Willey [7] and the LOM Standard [6] were analysed and its implications considered. As referred by Willey, the definition of LO proposed by the LOM might become confusing for the users, since the approach is too wide to be practical. So for this work, we adopted the same definition as Willey, a restriction to the definition of the LOM, "any digital resource that can be reused to support learning". Different explaining models were also analysed, like the Lego Metaphor, the Atoms Metaphor and the Construction Metaphor (as described in the Masie Report [8]). The latter is clearly the one that better explains the complexity of the educational process.

The main idea supported by the LO concept is the reusability of Learning Materials. To be reused, LO have to be described in detail, concerning many different aspects, and have to be made available for

potential users in a comprehensive way. Though, it is not surprising that the Learning Object Metadata Standard was one of the first structured approaches to the LO technology.

The LOM standard provides a detailed schema for describing several aspects of a LO, and provides an essential framework for developing LO repositories.

3 Proposed Method - The Learning Object Benchmarking System (bLO)

Any evaluation process implies the comparison with a standard. However, when evaluating of LOs there isn't a standard to compare to. This was the reason that led to development of a proposal to evaluate LOs comparing them with other LOs, using a benchmarking process. This method intends to be flexible enough to adapt to the various types of LOs and also to the constant evolution that this sector suffers. It also intends to be a useful and easy to use tool for teachers or other stakeholders to compare the performance of LOs with others, concentrating only on the features they want to evaluate. The method here proposed is based on the LOM standard, as a structural document, and for the benchmarking methodology we adapted the one developed by the European Project BENVIC - Benchmarking Virtual Campus [3,5], since the approach seems to be an adequate solution to the problems referred before (immaturity of the sector, diversity of contexts).

A. From BENVIC to bLO

The adaptation of the BENVIC methodology to the method of benchmarking LOs (bLO) had as main principle a reduction of scale. The first refers to Virtual Campus, an entity that relates to e-learning at the institution level (MACRO), and the second relates essentially at a MICRO level of educational materials. So, the adaptation process consisted on the transfer of principles and tools to the reality of LOs.

B. Principles of the system

Flexibility: The system should be flexible and easily adapted to the different stages of evolution of the learning objects, different types and quick changes. This led to the choice of a benchmarking evaluation system. Even though the LO definition adopted for this work is not as wide as the one adopted by the LOM, a LO can be as simple as an image or as complex as an entire course. Also, the system should also address the needs of the different stakeholders, teachers, e-learning developers or even institutions.

Multidisciplinary approach: When evaluating a LO, we have to consider not only the LO but also the circumstances in which is being used, the technology involved, the pedagogic strategy and all the other factors that can influence the performance of the LO. The evaluation should include not only the pedagogical and technological approaches but also economic, institutional and cultural factors.

Promotion of a collaborative approach: The whole concept of LO is by it self an incentive to collaboration since it promotes the reuse of Learning Materials. In theory, a LO can be used by different teachers and students on different Learning Environments. This evaluation system intends to create the means to facilitate the collaboration within the academic community, by making available an easy way to find existing LOs and its evaluation results, an evaluation performed by the real users.

Formative and summative approach: This method has as a final aim the improvement of results and processes through a comparative analysis of practices and processes.

Social and cultural differences: As it was previously referred, the evaluation of learning depends on the framework and social and cultural specificities might have a great influence in the performance of a LO. So, the results of an evaluation process must consider these cultural and social differences.

Adopt an evolutionary approach: The system should be flexible and open to adapt to the rapid changes that are usual in this sector. This evolutionary approach is possible through the updating of the tools by the contributions of all the stakeholders. By the continuous use, the system updates itself.

Consider the sensitivity of stakeholders: As referred, different stakeholders have different needs and perspectives in relation to the performance of a LO. So, the bLO must include a weighing system that relates the features of a LO to the specific needs of a stakeholder.

C. The tools of the bLO system

The bLO includes the following tools, essential to the benchmarking process here described:

1) Profiling tool for LOs based on the standard Learning Object Metadata

This tool intends to structure the information for the rest of the evaluation process. One other essential function of this tool is to constitute the basis for the creation of a standard repository of LOs. It is very important that the description of the LO is universal. Only by using a standard description of a LO, we can make comparison possible. Also, referring to a standard increases the potential use of the system. For this work, a restriction of the LOM standard was used to simplify the process of describing the LOs. Because it is intended to be used by different stakeholders, with diverse technical knowledge, a subset of this standard was used, adapted from a document created by the European project "Electronically Enhanced Education in Engineering: E3".

Also, we chose to use the LO definition proposed by Wiley [7]: "any digital resource that can be reused to support learning". This definition is also a restriction of the one included in the LOM document. Mainly, we intended that this profiling tool should comply with the standards but also it should be very easy and straightforward to apply. The wide use of this tool is critical for the success of a collaborative evaluation system as bLO. This profiling tool includes filling instructions and a mapping of the data collected to the LOM standard.

2) A system of indicators

After analyzing the LOM standard and the models for explaining LOs, indicators of performance were established, covering all aspects and features of LOs and its application. This tool also gives a relative position of a LO compared to all the others that have been evaluated and should clarify which part of the LO should be improved.

The indicators are the critical point of the bLO system since all comparisons between LOs will be based on this tool. For the development of this tool some principles had to be considered:

- The indicators should predict the use by any kind of LO included in the definition adopted
- It should meet the needs of every stakeholder of the process and follow the evolution of these needs
- It should contemplate the circumstances of application

However, at the moment this tool was created there was no quality criteria established for LO. We choose to develop an initial system of indicators based on the analysis of the LO concept as it is proposed by several models and entities. It is important to understand that, at this point, this tool intends to be a starting point, a working baseline for a more developed tool. The system has to be calibrated and validated, by applying it to several LOs, in different contexts, by different stakeholders.

The use of the bLO will create a critical mass that will help to understand how the LOs relate to the indicators, which ones should be applied in each situation and other crucial information. Also, the bLO should include a meta-evaluation system to make it a Continuous Improvement System. This will probably mean that in first phase of application the system will need major changes to meet the users' needs. But, it is intended that at a later phase, every use of the system will input small adjustments that will make it accurate and up to date.

One other important aspect, is that a continuous and wide use of the bLO, would create a LO dynamic quality standard that would evolve with the system, based on every LO included in the repository.

The first phase of development consisted in research about the LO and its features. Several models and definitions were analyzed in detail. Following, a concept map was built based on the information gathered before. Several important concepts related to the evaluation of LOs became evident. After that, four categories of attributes of LOs were established by grouping the information of the profiling tool: Educational, Technical, Structural and Logistical.

Finally, after the four categories were found and considering the results of the previous analysis, an embryo of an indicators system were established. As in BENVIC, three types of indicators were considered: Structural, Practice and Performance. To make easier the application of the system, we adopted the following marks for the indicators: (0) Not applicable; (1) Partially applicable; (2) Totally applicable. The performance indicators have different marks. For each category, several indicators were selected.

After the indicators were found we concluded that would be essential to relate this indicators with the reuse potential of the LO and its Learning efficiency. So, a weighing system was created that relates each indicator with these two fundamental characteristics of the LOs. This weighing system has to be calibrated and validated along with the rest of the system.

3) A map of competences and procedures

A map of competences and procedures is an essential tool to implement a continuous improvement plan, because it helps to identify the competences and procedures that are necessary to improve the LOs on the areas identified on the previous steps. To develop this tool, it is necessary to map the indicators in use to competences and procedures related to the development and application of LOs, and that only should be done after the indicators are in a more mature phase. As all the other tools of this system, this one should also include an evolutionary approach, should meet the needs of every stakeholder and should contemplate the framework of application.

4 Results and Conclusions

The system bLO here described is still in an early stage of development. Three fundamental tools have been developed: a profiling tool, an indicators system and a weighing system. The implementation phase has already started. The system was applied in two different contexts.

The first application of the system was to evaluate and compare three modules of a Master Course. This first implementation was very important to calibrate and test the system and also to provide information of its applicability. From this first step, some conclusions were found, regarding the tools. Regarding the applicability, the three tools tested, profiling, indicators and weighing system were easy to use and suited the different LOs tested. Looking deeper in to the tools, the profiling scheme was easy to use by the stakeholders, easily adapted to the different LOs and provides relevant information about the LOs. The system of indicators, associated with weighing system was also easy to use and provided marks that allowed the comparison among the LOs. Also, it helped to identify factors or problems that affect effectiveness of the LOs and its potential for reusability. However, this step also provided useful information about the system of indicators. Two main problems were identified:

- A group of indicators revealed structural problems, resulting on the impossibility to use them. They will have to be reformulated and included again in the system.
- Some indicators revealed a degree of subjectivity larger than it is desirable for this type of evaluation. It will be necessary to rewrite them.

The bLO system was later used as an evaluation tool for the European project "Electronically Enhanced Education in Engineering: E3". This project produced several Learning Objects that were used and tested by the different international partners. The bLO helped to do the transnational evaluation and provided information about the reusability potential of the LOs developed. As previously, the application of this method is easy and simple.

A. Future work

In the future, it would be crucial to apply these tools to several case studies. With the data gathered, the system can be calibrated and validated. Only then, the map of competences should be built. For this step, collaboration is critical, since inputs from different stakeholders are necessary to incorporate into the system a variety of perspectives.

One other important step is to build a repository of LOs based on the profiling tool. However, since the bLO is based on the standard LOM, it is automatically compatible to any repository based on this standard. At the moment several initiatives in this area are occurring, including one at University of

Porto. Later, it will be possible to connect these two systems, building only one interface of communication.

As future works, it would be interesting to develop weighing systems that relate the indicators with specific needs of stakeholders, with cultural and social specificities and with different kinds of LOs. This step will complement the system with information, making it more accurate to evaluate referring to context.

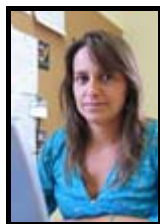
Finally, to complement the whole system, it is important to incorporate a tool for including the meta-evaluation of the bLO by the users validating it and feeding it back in to the system.

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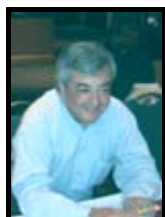
References

- [1] MORTIMER, L. (2001) *The Devil is in the Details: Converting Classroom Courses to E-Learning*, Learning Circuits, www.learningcircuits.com
- [2] CARVALHO, C. V. (2003) Defining an evaluation methodology for blended learning in Higher Education, Evaluating e-learning - Galecia Project
- [3] BENVIC (2000) BENVIC benchmarking system. Methodological Report
- [4] WILLIAMS, D. D. Evaluation of Learning Objects and Instruction using Learning Objects
- [5] BENVIC (2002) Evaluation Methodology Report - Benchmarking for Virtual Campuses
- [6] IEEE/LTSC (2002) Draft Standard for Learning Object Metadata Institute for Electrical and Electronics Engineers
- [7] WILEY, D. A. Connecting Learning Objects to instructional design theory: a definition, a metaphor and a taxonomy.
- [8] MASIE, E (2002) Making Sense of Learning Specifications & Standards: A Decision Maker's Guide to their Adoption, The Masie Center, evaluation

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