# Evaluating a Learning Management System improved with Language Technology

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**Key words:** *e-learning, Learning Management System, User Scenarios, Language Technology*

## Abstract:

*This paper reports on the results of a validation of a Learning Management System (LMS) that was previously enhanced with new functionalities based on Language Technology. By means of the user scenario methodology we show the beneficial effects of such technology on the whole of the learning process, from the annotation of Learning Object (LO) to the improvement of the learning experience of the learners.*

# 1 Introduction

In recent years we have seen the increasing adoption of Learning Management Systems by different organizations, from universities to Companies, while new LMSs keep coming up in order to meet the increasing need. At the same time, the potential of Language Technology (LT) to enhance e-Learning has been repeatedly pointed out. In particular, LT can be beneficial in two different ways. First, it can support content creators in their effort to provide additional information such as metadata. Second, LT can be employed to improve LOs retrieval for both tutors and students.
In the project Language Technologies for eLearning (LT4eL)[1] we developed tools in order to support these two different tasks: management and retrieval of Learning Objects. Specifically, we employed Language Technology resources and tools for the semi-automatic generation of descriptive metadata. We developed new functionalities such as a key word extractor and a glossary candidate detector, tuned for the various languages addressed in the project (Bulgarian, Czech, Dutch, English, German, Maltese, Polish, Portuguese and Romanian).

In particular, the ILIAS Learning Management Systems was extended with new functionalities to support the different actors in e-learning environments. ILIAS is a fully fledged web-based learning management system that allows users to create, edit and publish learning and teaching material in an integrated system with their normal web browsers.

In this paper we report on the evaluation of the different tools developed for Portuguese language. The main objective of this evaluation is to provide evidence regarding the measure in which Language Technologies can enhance the e-learning process. We report on the evaluation of an improved LMS, focusing on the effects on the students' learning process. Some preliminary results on tutor experience using the improved LMS are also presented. Through qualitative and quantitative evaluation we demonstrate the improvement of such new functionalities in the learning experience.

# 2 Improved Learning Management System

The LMS chosen for improvement is ILIAS [2]. This is a powerful open source web-based Learning Management System that allow an easy management of learning resources in an integrated system via Web Service Interface (SOAP).
Language Technology was used to improve three different activities: metadata creation, glossary building and document retrieving [3]. In order to support the metadata assignment activity, a Keyword Extractor was developed [4]. This tool allows for tutors to speed up the process of annotating Learning Object (LO) and for students, it provides a powerful way to search for documents.
In order to support glossary building, a Definition Extractor was developed [5]. By using this tool, a tutor can select a LO and automatically generate a glossary. Students can use it as well in order to obtain a draft overview of the concepts being defined in a Learning Object imported into the LMS or just search for a definition of a target term.
Finally, in order to improve the retrieval of LOs a Semantic and Multilingual Search Tool was developed [6]. A key component of this tool is an ontology and the annotation of the Learning Objects with their concepts. Accordingly, the search tool developed permits to retrieve Learning Objects according to the concept entered and its occurrence in the retrieved objects.

# 3 User Scenarios Description

The main hypothesis underlying this work is that the enhancement of e-learning systems with NLP and semantic web technologies increases the effectiveness of learning and teaching, and in particular, the effectiveness in locating relevant learning objects in the context of learning related tasks. This improvement is obtained thanks to new facilities to add metadata. The evaluation was based on the user scenario methodology [7]. Two different scenarios were developed, one for students and one for tutors.
Regarding the Tutor Scenario, two parts composed it. In the first part, we focused our experiment on the metadata generation. For this reason participants (6 university tutors) were presented with a LO in the LMS and were requested to generate a list of keywords and a glossary using the tools in order to make that LO available for a particular course.
Tutors used both version of ILIAS, the standard version and the improved version. We asked tutors for a qualitative appreciation of the improved system.

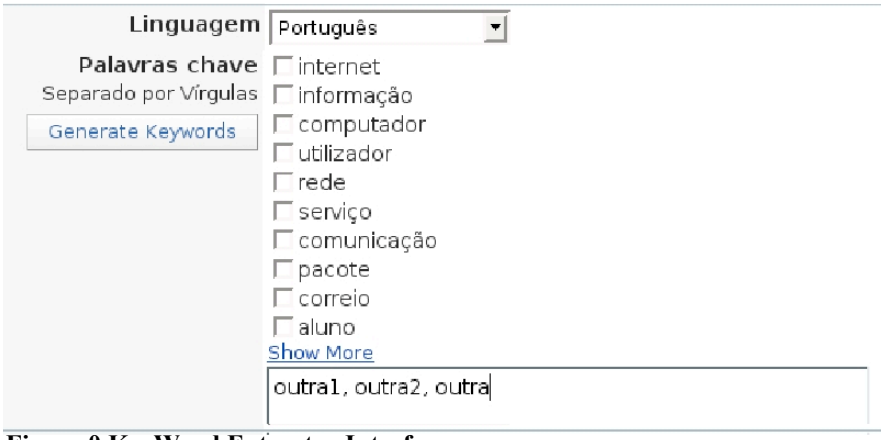


**Figure 0 KeyWord Extractor Interface**

Figure 1 and Figure 2 show, respectively, the interface for the Keyword Extractor and for the Glossary Candidate Detector used by tutors when faced with the improved version of ILIAS. For a selected LO they have the possibility to generate a list of possible keywords, select the

appropriate ones and add more keywords. Similarly, for a given LO it is possible to generate a candidate glossary, select the appropriate entries and add new ones. As the ILIAS standard version do not present such facilities, tutors generate keywords and glossary by hand when using this standard version.

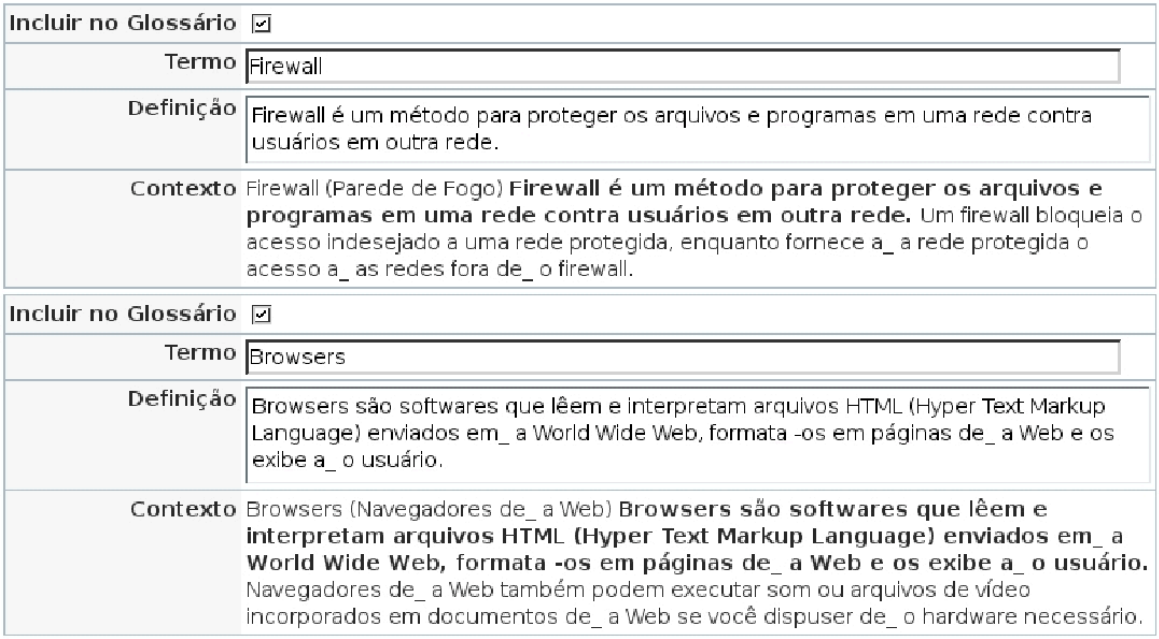


**Figure 2 Glossary Candidade Detector Interface**

The second part of the scenario was focused on the retrievability of LO by means of the new functionalities, namely search documents for keywords, semantic and definition. Tutors were presented with a list of topics related to a specific course and were asked to identify those LOs in the repository which would help a student to learn about those topics he or she is unfamiliar with. Tutors were asked to indicate documents in both Portuguese and English.
Figure 3 shows the interface the tutors were presented to accomplish the task.

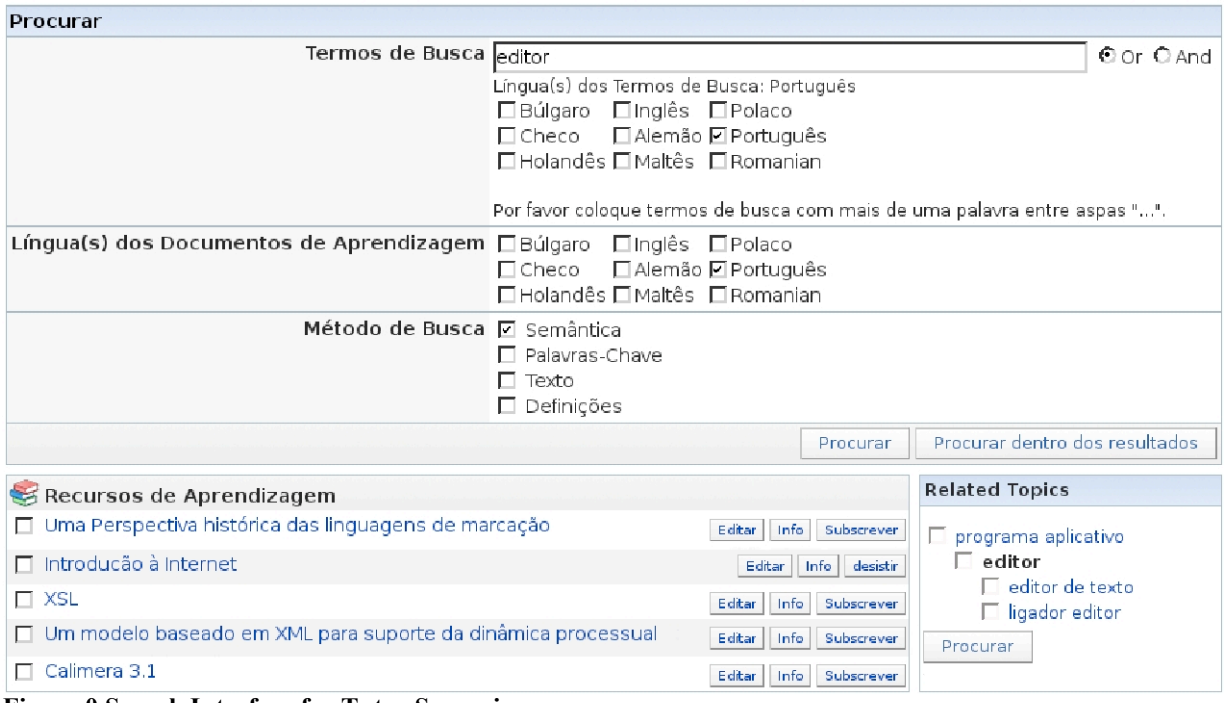


**Figure 0 Search Interface for Tutor Scenario**

As it is possible to see, tutors can choose among several search methods and several languages. Furthermore, it is possible to refine the search using the "Related Topics" frame on the bottom right of the page.
When the same task was carried out using standard ILIAS, the only facility was a simple text search method.
Regarding the Student Scenario, students were presented with a multiple-choice questionnaire and possible answers, and then encouraged to use specified resources to find the answer. Multiple-choice assessments were used to support our requirement for quantitative analysis and the comparison of scores. We tested our hypothesis with 24 undergraduate students. The students were divided into 2 groups, a target group using ILIAS in its standard version (ILIAS-ST) and its improved version (ILIAS-LT) and a control group using internet browsing in order to complete the task. Furthermore, all students were asked to answer a preliminary set of questions (pre-test) to assess their prior knowledge on the subject of study, and at the end of the experiment they answered another set of questions (post-test) in order to test the improvement in their learning. This arrangement presents us with a number of potential statistical comparisons to test hypotheses. Each question within the Quiz was timed by the system.
Figure 4 and 5 show respectively the two interfaces used by students during the scenario. The first one is very similar to that used by tutors, but the "Related Concepts" frame was expanded in a new interface in order to give more importance to hierarchical configuration of concepts.

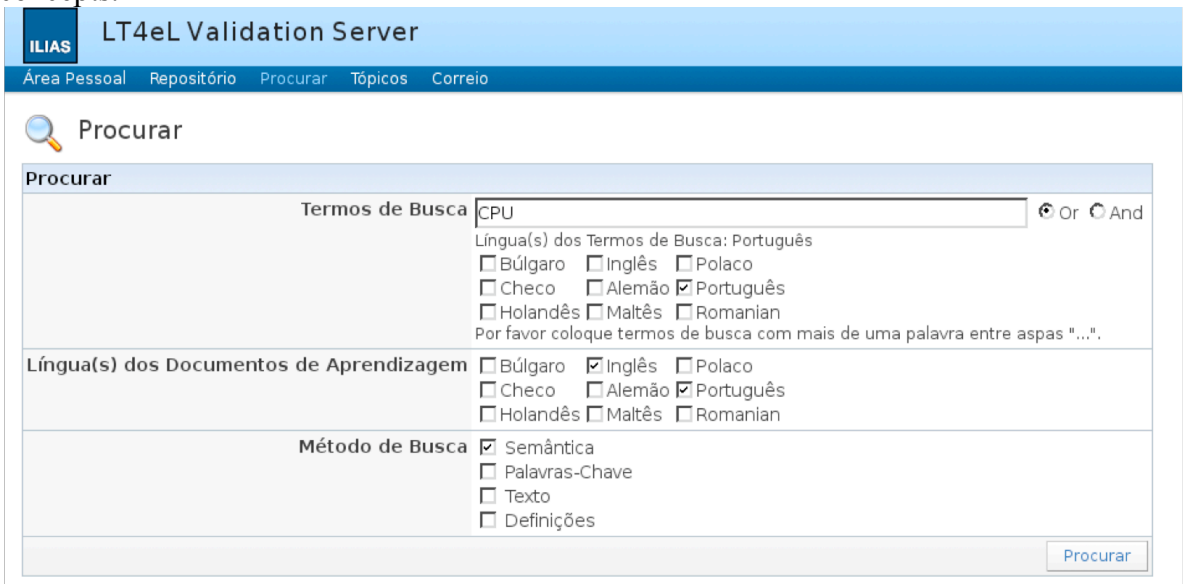


**Figure 4 Search Interface for Student Scenario**

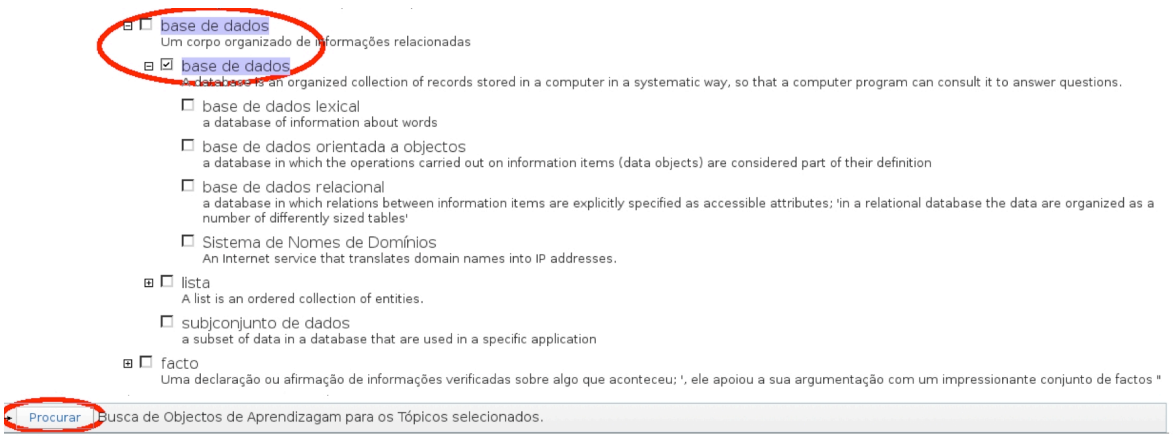


**Figure 5 Browser Concepts Interface Interface for Student Scenario**

# 4 Results and Discussion

Here we present some significant quantitative and qualitative results that support our hypothesis, that is, the enhancement of e-learning systems with NLP and semantic web technologies increases the effectiveness of learning and teaching.
Regarding the Tutor Scenario, we ask our testers do give a qualitative evaluation of the tool used. All testers (100% of score) agreed that both Key Words and Definition Extractors are useful, although 30% of the testers thought that the tools could be improved, and said they would use them if available.
Regarding the search facilities, tutors were given the task of refining a list of prerequisites for a given course, and to identify those LOs in the LMS repository that would help a student to learn about those prerequisites. Although for all testers it was easy to locate the relevant topics and identify relevant documents, 50% of them were not able to find some topics that they thought should be present. All testers agreed on the advantages of using such a tool in a virtual learning environment. When comparing with the ILIAS standard version all the testers agreed on the usefulness of the new functionalities.
Regarding the Student Scenario, we stored the answers provided and the timing of our tester, in order to compare their performance using different technologies: ILIAS standard (ILIAS-ST), ILIAS improved (ILIAS-LT) and web search.

| Group | Technology | Mean Score |
|---|---|---|
| Target | ILAS-LT | 5.27 |
| Target | ILIAS-ST | 4.72 |
| Control | Web | 4.90 |

**Table 1** Mean Scores

In particular, in Table 1 we present mean scores obtained by our students. The mean score is the average number of correct answers on a total of 7 questions. The group using the ILIAS-LT, followed by the group using normal web search, obtains the better result.

| Group | Technology | Mean Time |
|---|---|---|
| Target | ILAS-LT | 34.97 |
| Target | ILIAS-ST | 82.23 |
| Control | Web | 58.60 |

**Table 2** Mean Time

Table 2 presents the average time in seconds used to answer a question for each group and for each technology. The best result is obtained by ILIAS-LT. This means that the tools we developed are able not only to improve the learning process in terms of knowledge acquisition but also in terms of time spent in this process.

| Test | Group | Score |
|---|---|---|
| Pre-Test | Control | 3.28 |
| Post-Test | Control | 4.66 |
| Pre-Test | Target | 3.11 |
| Post-Test | Target | 4.83 |

**Table 3** Pre-Test and Post-Test Scores

Table 3 shows the pre and post test mean scores (where in this case the questionnaires were composed of 5 questions) for the two different groups. The improvement in the score for the target group (equal to 1.72) is higher than the improvement for the control group (equal to 1.38) using ILIAS standard.

# 5 Conclusion

Results presented in this paper support our hypothesis that Language Technology represents an immense potential for enhancing LMS, whose beneficial effects spread all over the learning process, from the annotation of Learning Objects (LO) to the improvement of the learners' learning experience. By the means of user scenarios, our experiment shows in which way these beneficial effects operate. In particular, students improve the process of knowledge acquisition in terms of quality and quantity. Regarding tutors, their benefit is in the time needed to carry out their task and the quality of metadata they produce.

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