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Towards a New Proposal to Evaluate the Learning Objects Quality in Learning Strategies for Education (QEES)

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Abstract. In Computer Science world several proposals have been developed for the assessment of the quality of the digital objects, based on the capabilities and facilities offered by current technologies and the available resources. Years ago researchers and specialists from both educational and technological areas have been committed to the development of strategies that improve the quality of education. At present, in the field of teaching-learning, another important aspect is the need to improve the manner of gaining knowledge and learning in education, which the use of learning strategies is a major advance in the teaching-learning process in institutions of higher education. This paper presents QEES, a proposal for evaluating the quality of the learning objects employed on learning strategies to support students during their education processes by using information extraction techniques and ontologies.

Keywords: Digital objects, learning objects, learning strategies, ontologies, teaching-learning, quality.

1 Introduction

Information Technologies (IT) have evolved notably in the last decade and start to have great impact on the organization of teaching and learning process. However, at present, the incorporation of IT is mostly considered as a means of encouraging learning and facilitating the creation of knowledge. The adaptation of the educational environment to the appropriate use and exploitation of IT and their potential benefits is still a challenge. [1]

The use of information technologies in education has been relevant to the development of distance learning processes and the creation of educational technologies for on-site learning. New technologies has been developed in a way parallel to changes in teaching methods and even how to design learning and teaching, where, more and more frequently, students take control of the process, choosing those materials and resources better adapted to their requirements and possibilities [2]. The appropriate use of educational technologies, which provide tools

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based on traditional educational theories, leads to a more effective learning process, the creation of content and use of new teaching aids to spread the knowledge [3].

The currently learning strategies are implemented a traditional approach that limits progress towards new ways of learning. Given the constant technological development, Learning Objects (LO) have become important resources in the teaching-learning process in institutions of higher education, which study and analyse new e-learning methods by defining learning strategies that extensively use LOs with the aim of improving the quality of these processes. According to [4], LOs are digital resources that can be reused to support learning. Given their relevance in the current learning scenarios, the concept of LO quality and the development of appropriate mechanisms for the evaluation of LO has been gaining importance, in order to ensure the access to learning resources with a certified quality level.

The definition of the concept of LO quality, which mainly depends on the definition of LO, could be established from different perspectives addressing different issues: the fulfillment level of its design requirements, usability, maintainability, problems of storage or retrieval, etc.. In order to avoid the ambiguity in the definition, it is necessary to define what specific features will be considered to evaluate LO quality. It is worth mentioning that, at present, this process is performed manually, and consequently, another problem of this evaluation is the bias introduced by human evaluators, who, depending on their personal background, might assign different scores to a LO. Thus, it is necessary to introduce measurement scales for quality that could be accepted by a wide group of experts.

In this context, we studied the LOQEVAL (Learning Objects Quality Evaluation) proposal [5] to be used in our methodology, it provides a new ontology-based method of assessing the LO quality in learning strategies. LOQEVAL offers a flexible environment, adaptable to any type of repository or platform for the development of learning. This paper presents the integration of LOQEVAL with a specific type of repository of digital objects, i.e., the Flexible Extensible Digital Object Repository Architecture (FEDORA) [6]. The proposal uses domain ontologies, the morphological analyzer Freeling [7], the Active Directory server of the Agrarian University of Havana and information extraction techniques, in order to establish definitions of learning strategies for future use by students and assessing quality of the LO used. This is still an ongoing investigation but in this paper we can describe our preliminary results.

The paper is structured as follows: Section 2 briefly describes the state of the art on learning strategies and the evaluation of the LO quality. Section 3 explains in detail the proposal and their stages and artifacts. Finally, Section 4 draws the main conclusions of this work and presents the main lines of future work.

2 State of the Art

New demands of society and the impact of new technologies are increasingly being felt in the world of education. Learning is not just about providing more training opportunities but also generating awareness and motivation to learn. It requires students who play an active role, able to learn in multiple environments and

personalize their learning processes based on their specific needs. Hence the need to resort to the use of learning strategies, they constitute some of the trends used in education. It is worth mentioning that one of the key components of any learning process is a learning strategy the learning strategies in conjunction with the content, objectives and learning assessment are key components of the learning process. According to [8] learning strategies can be defined as integrated sequences, with different extensiveness and complexness degrees, of actions and procedures selected and organized to address all components of the process, seek to achieve the objectives. That is, the process by which the student selects, coordinates and implements procedures to achieve a purpose related to learning. For the strategy to take place, planning is required of certain techniques in a goal-directed sequence. This includes the ability to assess a task and so, to determine the best way to do it and how to track the work done.

To define a learning strategy is necessary to use the LO stored on a digital objects repository, for our proposal we used the FEDORA repository digital documents. Which is a content management software that runs as Apache Tomcat Web service provides the tools and interfaces for the creation, ingestion, management and dissemination of content stored in a repository [6].

The use of LO is one of the most important trends in design education with the use of IT today. The central idea of a LO is not what is in itself, is it reusability. For reuse of a LO is necessary that the content is described through metadata. These are a set of attributes or elements necessary to describe a resource. Through them you have a first contact with the object and know quickly its main features.

Taking into account all mentioned it is necessary to know how a user can define a learning strategy and store it in an ontology. For this first we have to know how is define an ontology. In the world of computer science and communications an ontology is a conceptual representation of a particular domain that facilitates the exchange of information between different systems. Its aim is to define vocabularies fixed that the machines can understand, is why the vocabulary must be defined with great precision and allows differentiation of terms and referenced accurately. The fundamental purpose of an ontology is not to serve of vocabulary or taxonomy, it is the sharing and knowledge reuse between applications. Each ontology provides a description of the concepts and their relationships within a given domain, which can be shared and reused between different applications and intelligent agents.

Knowing what we explained before we can know how a user can define a learning strategy and store it in an ontology. For this we analyze the name of the strategy by the language parser Freeling open source, which allows morphological analysis, in addition to the segmentation of text into words, among many other features. The use of morphological analyzer Freeling eliminates words that are not relevant, which allows only search in the ontology the words that were not removed by Freeling. To carry out the learning strategies definition, the user must already be authenticated to the system. For this is using the Active Directory server of the Agrarian University of Havana, which verifies that can only access the system the users who are within the domain of the Agrarian University of Havana.

Moreover, current proposals for assessing quality of learning objects, such as [9], [10], [11], [12], [13], describe the parameters for determining the quality of a learning object and the process of obtaining each of them. The evaluation process is carried out

by experts, who ascribe a value to each parameter basing on their criteria. However, in these approaches, each organization defines its own quality parameters. There is no consensus on the parameters to consider in defining a quality model for LO. There is no automatic mechanism for facilitating the evaluation process from other information drawn from outside sources. This makes the process of updating and maintaining of LO repositories more difficult, taking into account their level of quality.

All this deficiencies are associated with the development of new research lines in order to improve and ensure the development of the learning process. It is investigated the applicability of the techniques of information extraction and use of ontologies as a support with the aim of facilitating their evaluation process. During this study we have found a high number of research institutions focused on educational initiatives to provide semantic descriptions for the management of learning objects in LO repositories. For example, the development of an architecture based on ontologies to retrieve information relevant to the learning objectives [14]; and the project elSEM (e-learning systems based on standard Semantic Web technologies), University of Alcala [15], with the aim to enrich and make learning processes more flexible by using ontologies and other resources.

In the study of the learning object quality, these new initiatives have not been used yet. For this reason, our evaluation proposal tries to integrate these initiatives, using ontologies as a support resource for automatic information retrieval, extraction or inference in the evaluation of learning objects.

3 Introducing the QEES Proposal

This paper presents the QEES proposal for the evaluation of the quality of learning objects used within learning strategies to support the student in education. The aim of this method is to select appropriate learning objects for defining a learning strategy to meet a request made by a student in a given situation. For this it must be used the FEDORA digital document repository, domain ontologies, the morphological analyzer Freeling and the Active Directory server of the Agrarian University of Havana. When learning strategy is defined, it will have a certain quality that is obtain once assessed the quality of learning objects defined in it, by using information extraction techniques and ontologies.

The first part of the process consists to define learning strategies. This part is divided into two processes: the Student Process and the Lecturer Process. Finally the second part is for evaluating the learning objects quality used in the learning strategies defined before, using the LOQEVAL proposal as described in subsection 3.3. Then subsection 3.4 explained the ontologies in the parameter management processes taking into account the previous subsection.

3.1 Student Process

Fig. 1 describes the actions taken by the student in the first phase to carry out this process.

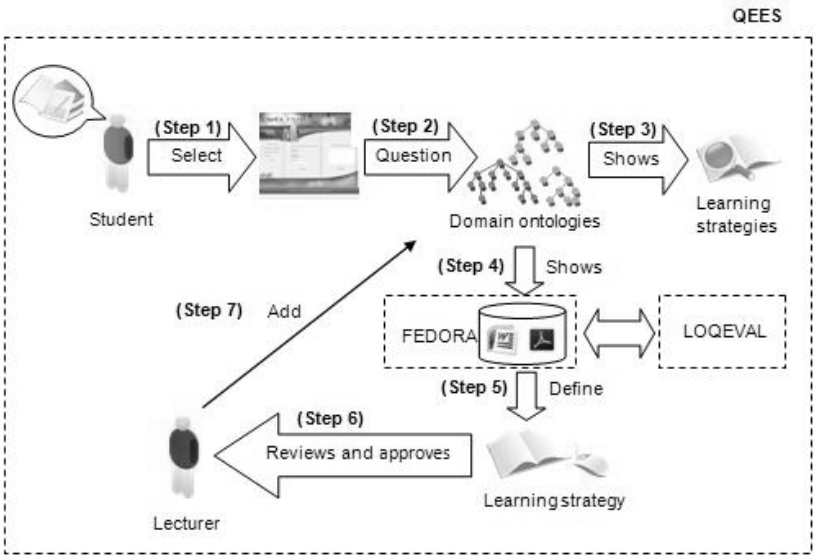

Fig. 1. Definition of learning strategies by the student.

In order to explain each step, we use a case study in which we describe the different user roles involved in the process as well as the processes performed and the artefacts managed by them.

Step 1: The student begins with a question on a topic of a particular subject. This requires user authentication to the system, in this case it is taken as an example a student whose user is "Peter". The Active Directory server is used to verify that the user is really within the domain of the Agrarian University of Havana. Once this verification is correct, the user can access the system. He selects the career to which he belongs, in this case the career of "Computer Science", the subject he wants to study, for example "Artificial Intelligence".

Step 2: The student formulates the appropriate question on which he wants to learn, such as "The depth first search", which will be examined with the morphological analyzer Freeling to eliminate the words of the question are not relevant, for example: articles, conjunctions, prepositions, etc., in order to leave only those words with which he can get what he needs. For this example it would not take into account the article "The", being then the words "depth", "first", "search". Once obtained these words, these are the ones that will be used to interrogate the corresponding ontology. For the example presented was used the ontology "Computer Science" corresponding to the career of Computer Science that was selected previously. It consists of three interrelated classes with information of the subjects of the career, the created learning strategies and steps to follow for each strategy. The aim of used this ontology is to check if exists some created learning strategy that relates to the resulting words obtained after applying Freeling to the request that would be the search criteria in "Computer Science". The ontology shows below:

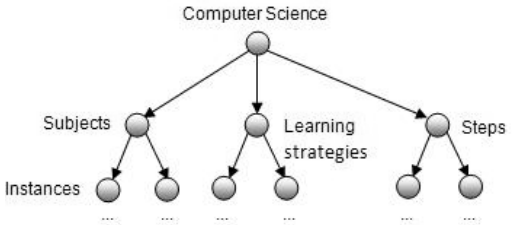

Fig. 2. Computer Science ontology.

Step 3: In this case if exists this strategy it is shows to the student both the name and the number of steps it contains. If not exists a strategy then would go to step 4.

Step 4: Start the definition of the learning strategy. First he has to define a name for the future strategy to create, for example take the same as the previous question: "The depth first search". Once defined the name you select the career to which it belongs, in this case "Computer Science" and "Artificial Intelligence" as subject for which the learning strategy will be created and displays a list of all the learning objects that are stored in the repository associated with the selected subject. It will analyze each one of these LO and the most appropriate are selected according to the request made. These LO stored in the FEDORA repository will be evaluated to analyze their quality level, with the LOQEVAL proposal detail in subsection 3.3. Which will allow to have in the below step a learning strategy with a higher quality level, because contain quality LOs. This is the main objetive of QEES proposal, it is to have learning strategies with higher quality to benefit both lecturers and students in education.

Step 5: Terminated this selection will begin to define the steps of the learning strategy named above. The number of steps that will contain will be those specified by the user. For the example that was followed they would be the following steps in the order that are presented.

- First step: Study the conference #3 named "Search methods".
- Second step: Travel the tree from left to right until the deepest level and only when you reach a dead end back to shallower levels.
- Third step: Study resolved examples of the practical classes #1 and #2.

First and third step refers to documents of the subject that are elaborated, are materials available to students, which contain a link to each one of them so they can be consulted.

Step 6: Upon completion all the steps, the defined strategy has to go through a stage of review and approve. The responsible for carrying out this phase is the lecturer responsible for the subject and his main objective is to verify that the defined strategy is properly prepared by the student.

Step 7: This stage is crucial as it will allow to add to the domain ontologies the learning strategies correctly defined, eliminating the possibility of inserting a strategy that is not properly defined or authorized by the lecturer of this subject. For the

example has been developed it will add this new strategy with each one of their steps as instances inside the classes that correspond it inside the ontology "Computer Science", for reuse by other students when they need.

Concluded this process was possible to carry out the definition of quality learning strategies according to the necessities that are presented to the student in a certain situation in a subject of its career, giving protagonism to the own student to feel the necessity to contribute their knowledge to other learners, by creating new learning strategies that will later be reused by other students, thus benefiting each of them in the knowledge that they can acquire and providing new learning methods for education.

3.2 Lecturer Process

Fig. 3 describes the actions taken by the lecturer in the second phase to carry out this process.

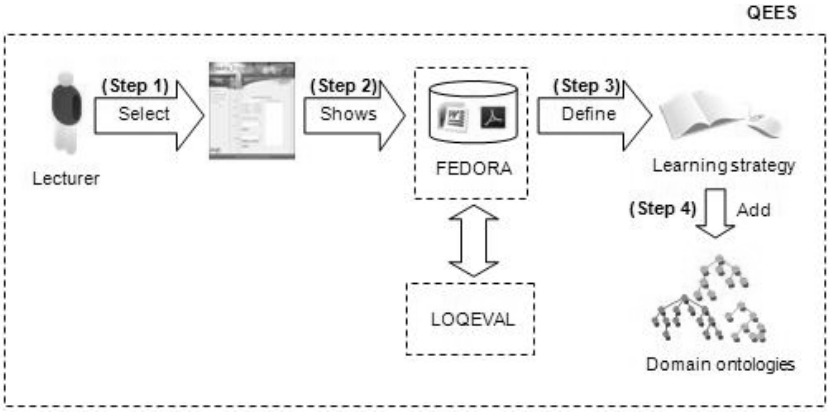

Fig. 3. Definition of learning strategies by the lecturer.

In the previous figure the definition of learning strategies that is done by lecturers is run similar to the one described in "Fig. 1" above detailed, for what an example won't be exposed to explain it because its primary purpose is only to define new learning strategies to make them available to students for study. So at each stage can take as an example the same as the first process, with the only difference in this case that the user is a lecturer and not a student.

Step 1: In this process, as in the above so that the lecturer can access the system is used the Active Directory server of the Agrarian University of Havana, to verify that the user is within the list of lecturers from the Agrarian University of Havana, so he can take out the whole process to be undertaken. When admitted into the system then he can run the process of defining learning strategies. First select the career and the subject which will create the strategy and define the name of the strategy.

Step 2: With these data he can get all FEDORA learning objects related with the information provided and they are shows to the user, in this case the lecturer. These LOs will be evaluated to analyze their quality level, with the LOQEVAL proposal

detail in subsection below. Which will allow to have in the below step a learning strategy with a higher quality level.

Step 3: These LOs are going to serve to define step by step the new learning strategy, as in the first process.

Step 4: Once fully defined will be added to the domain ontology with which it is related.

3.3 LOQEVAL Proposal

The LOQEVAL proposal [5] is aimed at facilitating the evaluation process of learning objects in LOs repositories, in this case as i.e. FEDORA, providing more flexibility in the selection of which evaluation parameters are the most suitable according to the criteria of the repository managers. Furthermore, it provides automated processes that allow the delegation of this task in intelligent systems. Finally, this proposal defines an evaluation method based on three main processes during the life cycle of a learning object (depicted in "Fig. 4"). LOQEVAL is used in the QEES proposal with the objective of obtain learning objects with a higher quality level within the FEDORA repository and therefore learning strategies with more quality in education.

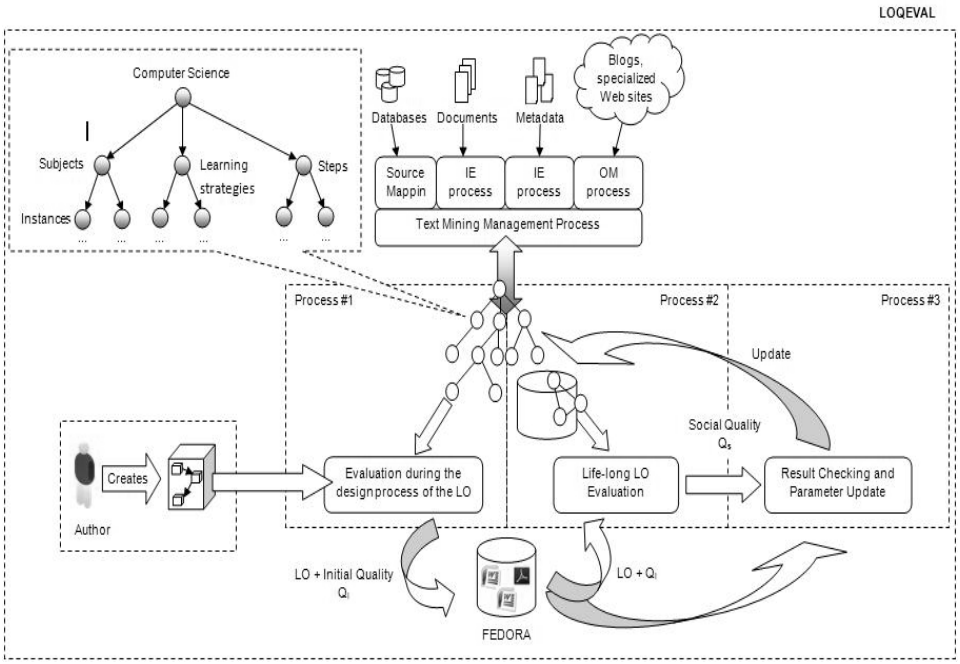

Fig. 4. Schema of LOQEVAL processes in the QEES proposal.

Each process is described in the following sub-subsections:

3.3.1 Process #1: LO Evaluation During its Design Process

The first evaluation process occurs during the period of LO design, using a collection of parameters defined by the repository administrator, e.g. the trust level of the information source or the number of relations with other LOs. In addition, a value of weight (w_j) is assigned to each parameter (f_j), taking into consideration its initial relevance. Weight values are initially set by the administrators or evaluators of the repository and, in following stages, they are updated automatically from the criteria of end users. Values for each parameter will be extracted from the LO itself (made of documents with different formats and contents, from HTML Web Pages to PDF files) and its metadata, which contains information related with the LO. The result of this process is what we have called Initial Quality (Q_i) of a LO, which is briefly defined as follows:

$$Qi = \sum j=1\ n\ (wj \cdot fj) \quad (\mathbf{1})$$

3.3.2 Process #2: Life-Long LO Evaluation

The objective of this second process is to evaluate a LO from a user-like point of view, i.e. once the LO has been used by common users. Another collection of parameters (F_s) is used in this process. In addition to considering the user context and the goal of the LO, it is necessary to analyze different criteria, both positive and negative, of the users who are using the LOs from the repository. Values of this type of parameters will be extracted from user opinions in e-learning Web sites by means of information extraction (IE) and opinion mining (OM) systems. Moreover, the detection of new evaluation parameters, not considered before, with a significant influence in this evaluation process is another goal of this process. The result of this process has been called Social Quality (Q_s) of a LO.

3.3.3 Process #3: Result Checking and Parameter Update

Finally, for each LO the evaluation results obtained in the first process (Q_i) are compared with the results of the second one (Q_s). The main objective is to update the quality parameters in order that the gap $\left| Q_i - Q_s \right|$ is minimised and, consequently, obtaining an initial evaluation process with higher accuracy. This initial process will facilitate the use of newly introduced LOs in a LO repository. Making the difference between the Q values smaller implies an update of both evaluation parameters and their weight inside this first process. These elements will be iteratively updated, each time a LO is used, thus gradually attaining an initial evaluation process more reliable and adapted to the repository context.

3.4 Ontologies in the Parameter Management Processes

In order to carry out the whole evaluation process, it is necessary to use information from either the author of a LO, the LOs itself or of the learning strategies. All this information will be managed by three ontologies: an author ontology, which will contain aspects of the author profile, a LO ontology, which will reflect the structure and the characteristics of a LO and a carreer ontology that will contain the created learning strategies for each subjects. Furthermore, quality parameters and evaluation rules will be represented in another ontology, an ontology for parameter management, which will be the key resource for parameter extraction systems. It will also contain rules for the management of the parameter and the calculation of the different quality values that are involved in our proposal.

These ontologies cannot be independent, since their contained knowledge needs to be used co-ordinately in order to obtain the required quality values. Therefore, there will be multiple ontology relations between them and also relations with upper ontologies to contextualize the captured knowledge.

Another important aspect of our proposal is the necessity of a knowledge base (KB) to store all the instances of these four ontologies. Our KB will contain the necessary information for the development of all the defined processes, from parameters or weights to information about the process of extraction of information (where, how to extract the required information).

4 Conclusions and Future Work

The QEES proposal facilitates the measurement of learning objects quality level used in the learning strategies definition, incorporating the use of ontologies as a support resource for automatic information retrieval, extraction and inference in the evaluation of learning objects.

Users will benefit by having a system that will allow them to define and reuse learning strategies that contain learning objects that will be assessed with the LOQEVAL proposal, so it will ensure a predetermined quality level.

The proposal will allow lecturers to assess student performance in learning strategies definition, using a new study method in no presential education.

The QEES proposal aims to benefit both lecturers and students in education and ensuring at the same time the use of learning objects with a predetermined quality level.

The final scope of this research is oriented to: (I) defining ontologies for the parameter management processes, (II) creating of specialized learning strategies for each user, (III) implementing the proposal to learning objects stored in FEDORA, (IV) evaluating that the applicability solves the problem of user.

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