

TrAgLor: A Multilingual Learning Objects Repository for Agriculture and Life Sciences

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Learning object repositories are the systems that store learning resources and their associated metadata in order to provide efficient search and access mechanisms. The Turkish Agricultural Learning Objects Repository (TrAgLor) is a multilingual, domain specific, and IEEE LOM Draft Standard-compatible learning objects- and learning objects metadata-repository system. Although it primarily aims to store digital learning resources that have been produced for agriculture, veterinary, food, environmental and forestry sciences it also targets to include the objects for all related basic and applied sciences such as biology, botany, zoology, genetics and bioinformatics. The content of TrAgLor is provided and enriched by member users' contributions, discussions and evaluations. All of the objects and related metadata are also reviewed and rated by disciplines editors, and if necessary they are classified and refined on their general, educational and technical properties before publishing in the repository.

Index Terms— Agricultural learning, Learning objects, Learning Objects Metadata, Learning Object Repositories

I. INTRODUCTION

LEARNING object is one of the new concepts in delivery of learning resources to learners in e-learning design and development. There have been many studies on the subject, some of them are being carried out to describe and to set standards on learning resources while the others are in progress to realize their applications in education.

A. Learning Objects

According to IEEE Learning Technology Standards Committee, a learning object (LO) is defined as “any entity - digital or non-digital- that may be used for learning, education or training” [1]. Although this very broad definition of LO includes non-digital entities, LOs are generally defined as “digital resources that support learning” [2] with the idea of breaking educational content down into small chunks that can be reused in various learning environments, in the spirit of object-oriented programming. Thus, this idea enables the digital resources ranging from a simple music or text file to a whole course and even to an institutional curriculum and much more complicated structures to be regarded as learning objects. This approach, too, can be seen as to be broad to include terabytes of data on the networks on one hand, and also to be enough to emphasize the reusability on the other hand. However Harman and Koohang defined that “a learning object is not merely a chunk of information packaged to be used in instructional settings. A learning object, therefore, can include anything that has pedagogical value - digital or no-digital such as a case study, a film, a simulation, an audio, a video, an animation, a graphic image, a map, a book, or a discussion board so long as the object can be contextualized by individual learners” [3].

Contrarily McGreal concluded that LOs are digital resources and defined that they can be “any reusable digital resource that is encapsulated in a lesson or assemblage of lessons grouped in units, modules, courses, and even programs. A lesson can be defined as a piece of instruction, normally including a learning purpose or purposes” [4]. Similarly, Nash defined that a learning object is “a digital resource in any size and format which can be online accessible and reusable in teaching and learning via online networked environments in order to achieve the desired learning outcomes or educational objectives” [5].

As a conclusion from the discussions above, a commonly agreed point on defining learning object is that it should have a pedagogical value or educational objective, content and feedback/assessment with some levels of interaction. In this paper, we recognize that a learning object can be a small and standalone digital file or a large collection of files focusing on a certain topic to teach and/or learning a topic.

B. Learning Objects Metadata and Repositories

Learning objects are identified with their metadata. Metadata can simply be defined as “data about data”. A learning object, digital or non-digital, can be identified with its descriptive data called as “learning object metadata”.

Although there are a number of metadata standards and application profiles, Dublin Core Metadata Initiative (DCMI) and Learning Object Metadata (LOM) are widely applied standards in building metadata for learning objects. DCMI has specifically not been developed for educational use but it has also education-specific elements and qualifiers for describing learning resources. However, LOM Standard (IEEE 1484.12.1-2002) published by IEEE Learning Technology Standards Committee (IEEE LTSC) [1], is the principal standard for describing learning resources.

To promote the use of learning objects in education, two requirements should be matched basically. The first is availability of LOs by the design and the development

works, and the second is to enable the users to find, download and reuse them easily. In finding and reusing the LOs, Internet enabled systems, designed with storing, indexing, and searching engines are needed. In order to satisfy these needs, Learning Objects Repositories are the content management systems having these kinds of services for learning objects. Sometimes, even LORs are perceived as specialized type of search engines and/or vertical portals this is not completely true. This confusion is originated from the similarities of those systems because of their indexing and searching services, and content management. Nevertheless, when learning objects can be searched on search engines and/or portals, such problems and difficulties arise:

- Difficulties in finding discipline specific resources,
- Difficulties in filtering resources found for a personal learning objective,
- Lack of technical features and quality assurance of the resources,
- Lack of educational value and properties of the resources,
- Uncertainty in compliance criteria of the content for a specific learning purpose.

In the last years it is becoming increasingly difficult to limit search process to a context that is meaningful to a given user group or discipline [6]. For instance, an exact phrase search for "growing tomatoes" in Google (<http://www.google.com>, on Jan 2008) returned 245,000 results in various file formats, sizes and quality located in thousands of web sites at different domains from commercial to education. Checking and filtering a high volume of information for an average learner is really time consuming work. Moreover, it is a reality that the most of users may not distinguish the educational quality of the documents listed in results pages returned by the search engines. So there is a need for specialized systems that use the certain descriptors and identifiers from the metadata schemas to describe learning resources. Today, Learning Objects Repositories (LORs) are the content storage and retrieval systems to match this need in finding the learning objects. LORs manage the learning objects with their metadata, defining the general, technical and educational features of LOs, and also copyrights and evaluations on them in addition to searching and accessing them. Moreover LORs highly facilitate searching and filtering the learning resources when they compared to the search engines, indexing every kind of online material located in the Web.

The possible benefits of LORs can be summarized as:

- Collection, presentation, and management of learning objects in a central repository which can globally be accessed on the Web,
- Cost savings by avoiding repetitions in learning resources development,
- Promoting high quality objects production and sharing,
- Enabling learning resources exchange.

Although the most of the general purpose repositories also store agricultural learning resources they mainly manage the

objects from all scholar disciplines. In a study carried out by Tzikopoulos et al. in 2005, 59 repositories were examined in different aspects, only 3,200 over 881,000 learning resources were reported to be directly related to agriculture [7]. This evidently points out that the object repositories storing agricultural learning objects are needed for enabling easy access to these objects, where informal and lifelong learning needs too high in agriculture and food. In recent years there have been several approaches in developing educational metadata schemas or application profiles for agricultural learning resources. A small number of these approaches are application profiles based on the IEEE LOM Standard [8].

In 2007, The Agricultural Learning Repositories Task Force (AgLR-TF) was launched to set up a network of organizations that will promote the development of a global infrastructure to facilitate sharing and reusing of learning resources on topics related to agricultural and rural development worldwide [19]. At the Web site of AgLR-TF, 10 systems are listed as agriculture and rural development LORs.

The CG-Online Learning Resources system which was set up for agricultural usage (<http://learning.cgiar.org>) by CGIAR with partnership of ARIADNE has the feature of being an learning content management system (LCMS) besides being just a repository system which uses an application profile based on IEEE LOM [9].

In order to provide structured access to FAO's agricultural learning resources and capacity and institution building services, FAO started a project called the "Capacity and Institution Building Portal" in 2006. To ensure that the FAO portal can be searched by users and to enable interoperability with other recognized educational repositories, an application profile (AP) was created conforming to available and commonly used standards, to describe agricultural learning resources [10].

Bio@gro (<http://biagro.aula.gr>) which has been developed as an EU Frame 6 Project led by Agricultural University of Athens is a successful example of the agricultural objects repositories, storing organic agriculture content [11].

EcoLearnIt (<http://ecolearnit.ifas.ifl.edu>) has been developed by the University of Florida, USA [12] and DELOR (<http://mansvu.mans.edu.eg/delor>) of Mansoura University, Egypt [13] are the objects repositories which densely store objects from life sciences disciplines including agriculture, specifically. Apart from these, Wisconsin-Online repository of Wisconsin University (<http://www.wisc-online.com>) includes some agricultural learning objects although it is not specially established for agriculture and life sciences.

In the most of agricultural LORs, the application profiles have been created by selecting and refining a subset of elements from the IEEE LOM. The Agricultural Learning Resources Application Profile (AgLR-AP) mainly uses DC metadata and borrows some elements from IEEE LOM draft standard. Manouselis *et al.* proposed a metadata application profile that has been developed to support an online repository that supports vocational training needs of small

and medium enterprises in rural areas [14]. The proposed schema is also based on IEEE LOM, and originally has been called as The ReGov LOM application profile. ReGov AP has been used to support the description and classification of learning resources for rural SMEs in the Rural-eGov Observatory.

Another metadata application profile is the CG LOM Core that based on IEEE LOM in order to describe learning resources from agricultural domain [15]. Schenck-Hamlin and Zhan recommended that vocabulary pertinent to precision agriculture be identified from ASAE glossaries and organized into a three-tier system of descriptors and keywords recommended for use as precision agriculture metadata content [6].

In this paper, a multilingual and IEEE LOM Draft Standard compatible learning objects- and metadata-repository system called "Turkish Agricultural Learning Objects Repository (TrAgLor)" is introduced. As a domain specific system, TrAgLor aims to enable the teachers, instructors and students, initially in agriculture, food, veterinary, environment and forestry fields and also relevant basic and applied disciplines of life sciences, to store, browse, and share their experiences and opinions. In the paper, firstly we introduce the system architecture and main functional work flows of the repository. Then, we discuss operation and sustainability models and give some usage statistics of the system.

II. SYSTEM ARCHITECTURE AND FUNCTIONAL MODEL

A. System Architecture

As shown in Fig. 1, TrAgLor has a Web-based system architecture comprising of three tiers which are client tier, applications tier and data tier.

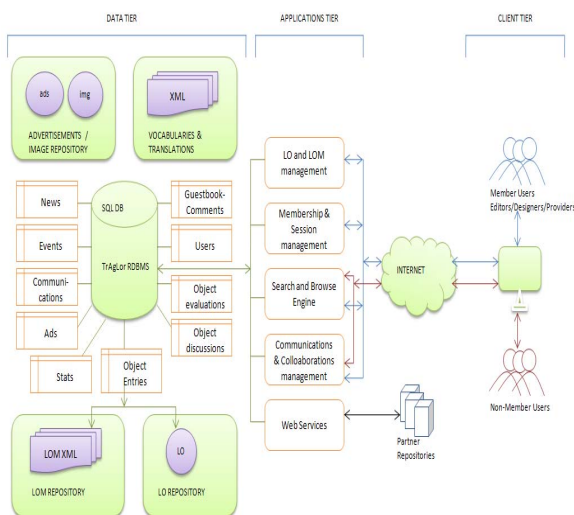


Fig. 1. General system architecture of TrAgLor

1) *Client Tier*: In a three-tier system, the client tier is generally a Web browser, processing and displaying data on

client side. Since TrAgLor has been developed as a server-side solution, there are no browser limitations and any special requirement is not required at the client side.

2) *Applications Tier*: The applications tier of TrAgLor is consisted of the software components of the system. The components in this tier receive the client requests and execute add, update, search, browse, list, and communication operations on the data tier of repository as responses..

As shown in Fig.2, the applications tier of TrAgLor contains 6 groups of the server objects and server side scripts for:

- Membership and session management,
- Objects and metadata management,
- Objects search, browse and list engines,
- Non-objects content management (news, events, links, evaluations etc),
- Communication and collaboration management (annotations, RSS feeds, e-bulletins, guestbook) and,
- Web services for metadata exchange.

2.1) *Membership and Session Management*: Membership and session management consists of server-side software components enabling logging-in, logging-out, members' roles, profiles and preferences registration into the repository. The users of TrAgLor are classified into 5 groups: visitors (ordinary users), members, content providers, editors and system administrators. In TrAgLor, there is no limitation to search, list, view or download the objects; however, member users can add objects and metadata, and have some exclusive rights on accessing services like high quality objects, e-bulletins and RSS feeds for news and events. Member users, editors and administrators can use the membership area to manage their own objects, metadata and other contributions for updating after logging in the system.

2.2) *Objects and Metadata Management*: The metadata repository of TrAgLor is fed via user interfaces enabling objects and metadata addition by member users, content providers, editors, and system administrators. As seen on the screenshots in Fig. 2, object and metadata adding and updating can be made in four ways:

- Add object (simple method)
- Add metadata (classical method)
- Add metadata (TreeLom method)
- Upload metadata (upload method).

Simple method of object addition enables the members, who do not have enough experience about the standards of learning objects and metadata, to add objects in a traditional and fastest way. As adding an object, such entry is done as required metadata elements about the object. These elements are title, key word(s), language and description from general category; location, format, platform and browser requirements from technical category; age group, learning resource type, intended user roles from educational category; contributor's role, name, version, status and date from life cycle category; copyright, price from rights category; role, entity name and date from meta-metadata category. The metadata elements of LOM categories listed

above are provided with users' entry but the meta-metadata (such as name and role of contributor, entry date and

metadata language) is created automatically by the system out of the user profile.

In addition to LOM elements, some extended elements such as the location of object logo/screenshot, format, primary audience and source code availability of the objects are also asked during object adding. Although these elements are non-LOM elements we believe that they are useful for the users. For example, a logo/screenshot image of an object is displayed in its summary page gives a prior impression on what the object looks like. Displaying the logo/screenshots of the objects is also a helpful design approach which has been applied in the most of repositories running today. During metadata entry for the extended element set is recorded into LO entries table of the RDBMS but not included in related metadata file, created in XML format and saved in LOM space of the repository. The Object IDs is used to link an object entry with its LOM metadata file, and this link is automatically created during metadata entry and object uploading. Consequently, in TrAgLor, since we build metadata with only LOM element we do not apply a specific metadata application profile with TrAgLor.

Although in simple metadata In the classical method of entry, metadata is added via a classical web form containing the input boxes for all LOM metadata elements defined in LOM Standard such as general, technical, educational, lifecycle, annotations, classification data, meta-metadata, rights, and relations. In this method of metadata entry only one instance of each metadata element is created due to offer simplicity to an average user. In the same time, practically describing only one instance of any element of LOM is enough for many cases. For example, a user who only speaks Turkish will not consider creating many instances of title element in other languages. Therefore TrAgLor provides this sort of metadata entry is an option for its users who wish to enter metadata simple just in one human language.

As understood from the screenshot in Fig. 2b, in the classical method of metadata entry another technique applied in form design is to switch "hide/display" buttons for each category of LOM. For example, a user who does not wish to enter "relations" category of LOM he/she can skip this category via keeping this section as "hidden" if he/she switches the button to "hide" position. In this way, during metadata entry only one category can be displayed on viewable area of screen, and thus metadata entry can be done more quickly.

As seen in Fig. 2c, using TreeLom, a tree-view metadata editor, is another method that enabling the entry of all the LOM Standard complied elements in more detailed but easy way. TreeLom makes possible to create the multiple-instances of any LOM element which is not possible in simple and classical entry methods as explained above [16]. Namely, in a metadata entry which includes both the editor and the graphic designer of a certain object at the same time, two instances of lifecycle contributor element are required under lifecycle category of LOM. In this case the contributor element should be created twice, one for the

a-Add object (simple method)

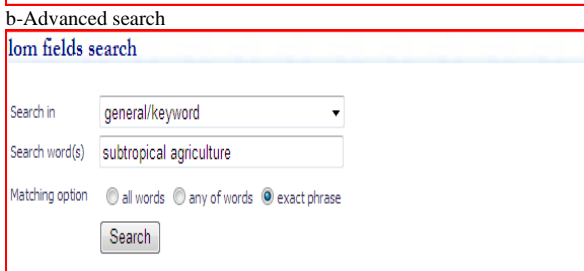
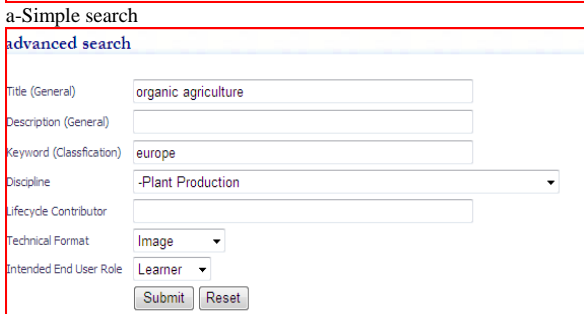
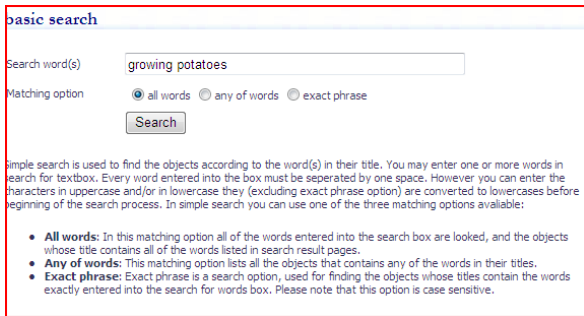
b-Add metadata (classical method)

c-Add metadata (tree view method)

d-Add metadata (upload method)

Fig. 2. Sample screenshots for objects and metadata adding methods

editor and the other one for the designer. For this kind of requirements TreeLom is used to create multiple instances of same XML element, and thus it makes a fully LOM Standard complied data entry is possible. Since TreeLom enables metadata entry in a tree view structure, the users can create several instances of any element in the limits of occurrences defined in IEEE LOM standard.



d-Fulltext search
Fig. 3. Sample screenshots for object search

Another option in submission of metadata to TrAgLor is the metadata uploading method. If an object metadata is formed in user's local system it can be uploaded to TrAgLor repository via uploading. The metadata uploaded to the repository is automatically validated and checked by a LOM XML validator in terms of LOM compatibility, and then transferred to a temporary LOM space for editorial review.

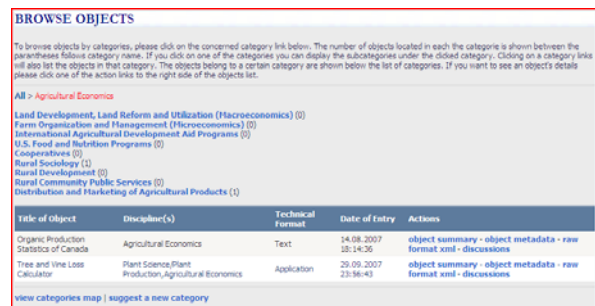
As a conclusion, it may be necessary to have enough information and experience about LOM Standard in order to make metadata entry via classical method and TreeLom editor. These methods are thought to be used by the

experienced members, editors and administrators of TrAgLor.

2.3) *Objects Search, Browse and List Engines:* Objects search, browse, list and display components are the central components of the repository which can be accessed by all users. The objects stored in TrAgLor can be searched via following search options:

- Simple search,
- Advanced search,
- LOM fields search and,
- Full-text search.

Simple search is a search method which seeks for the word(s) to be searched in the titles of the objects, as sampled in Fig. 3. In this type of search, although the default connector is "and", queried words can be combined with "and", "or", and "exact phrase" options. When the words searched with exact phrase search option they are queried as they just entered into the input box.



a-Objects browse via navigation through the categories



b-Objects browsing on category map
Fig. 4. Sample screenshots for objects browse

In TrAgLor, advanced search is a type of search which enables to search on one or more elements of an object metadata like title, description, keywords, disciplines, contributors (in the role of writer, editor, designer etc.), technical format (image, application, presentation etc.), the end-users (role of student, teacher etc.). In advanced search if a user enters/selects the words for more than one element they are combined with "and" in relevant SQL query. If the search is made without entering any information for any of these fields, then the metadata of all the objects are listed.

news, announcements and other calls to its users. This task is managed by an internal communication subsystem that has automated and/or manual control routines running on an users table of main database system.

2.6) *Web Services*: The Web Services of TrAgLor can exchange the metadata records in other objects- and/or metadata-repositories, and publish its own services to export TrAgLor objects to the partner repositories

TrAgLor Web services has been organized with Universal Description, Discovery and Integration (UDDI) standard and developed with SOAP on HTTP for data exchanging. In order to realize metadata import from TrAgLor, the client systems can invoke Web services available at TrAgLor by accessing Discovery Protocol (DISCO). With the DISCO document of TrAgLor, just a simple XML-formatted file which gives details about Web services location and WSDL access information. In order to provide the details about the Web Services we have a Web Services Description Language (WSDL) document which defines the names, input arguments and outputs of available functions of Web services of TrAgLor. Also, in TrAgLor several examples of Web services clients have been put into operation to demonstrate the use of TrAgLor's Web services.

3) *Data Tier*: Data tier, the bottom tier of TrAgLor, consists of 2 principal components: Main database system and repository spaces. TrAgLor database includes the tables, stored procedures and queries to manage the objects and non-objects content such as metadata, evaluation scores, user profiles and comments, news, events, and statistical information. The repository spaces of TrAgLor store four groups of the content files. They are:

- Objects repository space,
- Metadata repository space,
- Translations and vocabularies, categories space,
- Image gallery and advertisements banners space.

The objects repository space is used to store the local objects designed and/or submitted by member users, designers and editors. The metadata space holds metadata files of the objects which are in XML format and built compatible to IEEE LOM Standard.

As a multilingual repository, TrAgLor also contains language translations of the interfaces, categories, and IEEE LOM and TrAgLor's own vocabularies. All these translation files are the documents in XML format and managed by applications in an automatic selection base. In data tier of TrAgLor, there are also various galleries of images, videos and banners which are used for design and learning aims.

B. *Displaying and Accessing the Objects*

The metadata indexed by TrAgLor can be accessed in many ways of retrieval mechanisms. As explained in the previous sections, they can be accessed via search, browse or list operations. The objects found or filtered in these operations are listed in the results pages. In every results page, the objects are listed with their title, discipline, technical formats, date of entries, hits, and locality (local or remote). On any page of lists, while "local objects" are marked with a green icon of TrAgLor, the others are shown

with a gray coloured icon. On the right end of each line in the list pages there are four action buttons for viewing object and metadata (table view and xml view), and entering and seeing the discussions associated with the object.

If the action button for object view is pressed in the results pages, an object summary page is displayed for the selected object as like in Fig. 5. In this page, users can see some of metadata elements, and access the objects when they click the "view object" link. Additionally user can discuss the object via "discuss object" link or rate the object via pressing the stars displayed as the score indicators between 1 and 5.

Metadata of any object can be seen in tabular and XML view styles according to the users' preferences even mostly tabular view is preferred. In tabular view of metadata the system uses XSLT templates to show metadata via reading from the related XML formatted LOM files stored in metadata repository space of the system. XML view means that the object metadata will be shown in raw XML format as is they coded. This view is provided to the users for just copying and pasting metadata to their applications without an extra need for a tool to rebuild them.

The objects are also accessed via links provided on the homepage of TrAgLor as seen in Fig 6. When the users accessed to the homepage of the repository they see some panels in which 5 randomly selected objects are listed. These panels are TrAgLor objects panel, hottest objects panel, fresh objects panel, editor's choices panel, and randomly selected objects panel. Apart from that, news and announcements, upcoming events calendar and 3 nearest upcoming events can be viewed on the homepage.

As seen in Fig 6 thematic images selected randomly from a rich images archive and change on every access can be viewed as a background banner at top of the homepage. These images are displayed with additional tip texts which is also educative for the users.

III. MULTILINGUAL DESIGN METHODOLOGY

Since TrAgLor is designed as a multilingual repository, the user interfaces in Turkish, English and German language are available while French and Spanish language translations are under construction at the present time. When a user accesses TrAgLor, the content is displayed in browser's default language; however, he/she can choose a different language from the language options of the dropdown box located on the top-right corner of the homepage as seen in Fig 6.

The translation file for each language is named as "language_Ing_code.xml" in the translations space of the repository. For example the translation file for German is "language_de.xml". As the browser language parsing script that resides on master page of applications, the language code with two letters are striped out and then relevant interface translation file is loaded from the translations space. The interface translations are XML-formatted files and contain all prompts, captions, messages and names used in web forms and pages in each language. Since these elements to be displayed on the pages are coded as variable

in every application component they are replaced with appropriate translations when they accessed.

Besides the translations for the user interfaces, TrAgLor also uses the translations for the vocabularies and classification categories. The vocabulary translations are the XML-based files that contain all vocabularies for some metadata elements like aggregation level, technical format, intended end users roles etc. In each translation of the vocabularies we have two types of vocabularies such as LOM V1.0 vocabulary and TrAgLor's own vocabulary. The vocabulary translation files are called object and metadata adding process and used to populate the selection and radio controls for relevant metadata elements in the input forms.

TrAgLor's third group of translations consists of the category maps used in classification of the objects. These files are the translations of AGRICOLA subject categories, and called in metadata adding forms to populate the disciplines (to fill in classification taxonpath entries of LOM). This type of selection eases and shortens the metadata inputs for classification purposes.



Fig. 6. A sample screenshot of homepage of TrAgLor.

IV. QUALITY CONTROL OF THE OBJECTS

The metadata submitted into TrAgLor are reviewed and edited by disciplines editors assigned by system administrators. The main principles in the reviewing process are:

--Language and writing quality: The objects should be free from spelling and grammar errors.

--Educational quality: Object should be prepared for educational purposes. The content of an object should encourage the students. It should facilitate learning and/or teaching.

--Technical quality: An object should be up-to-date and applicable with a wide range of different operating platforms and Web browsers, and work without any problem. It also should be accessible on-line.

--Design quality: The objects should be designed as easy-to-understand and easy-to-navigate.

--Reusability: An object should be reusable in different educational domains. It should be in the very first stage of aggregation structure (in atomic level) as possible as it can be.

--Compatibility: The metadata should be formed in IEEE LOM Draft Standard and vocabulary suggested in this standard.

The reviewing mechanism of TrAgLor is very similar to that used for manuscript submissions in the scientific journals. As the editors log in the system, the metadata of the objects submitted to the system is displayed in their task list. The editors can discard the objects if they find them unworthy, or make technical corrections, if she/he regards it is necessary. The editors rate the objects between 1,000 and 10,000 according to its educational and technical quality. While the scores are converted to a 10 points Likert scale by dividing them into 1,000, they are also used as maximum display counts of the object on the homepage and listed as editorial scores. If an object has at least an editorial score over 5,000 (5 in Likert scale) is considered as a "quality object", and published in the "editors' choices" panel of the homepage of TrAgLor. The view counts of the metadata (hits) are increased in each time as viewed, and when the score reaches to its editorial score then it is taken out of the editor's choices panel. These hits counts are used to show popularity of the object listing and metadata display pages of the related objects.

The objects can be also evaluated by users with a score between 1 and 5. This kind of rating is done by simply clicking an appropriate star representing the scores on metadata tabular view window for the objects. Scoring is controlled by client side scripts in order to prevent to give score more than once, and recorded into scores tables for also controlling it in later accesses of any user. Users can also enter their opinions and remarks on the use of any object via clicking "discussions" button on tabular view page. The data entered in this way are recorded into "discussions" table of TrAgLor database and tracked with object ID later. In TrAgLor these contributions are regarded as annotation elements of LOM but not inserted into metadata file because they can be reached to a high volume as much as not control in a metadata file easily.

V. CONTENT AND USAGE STATISTICS

The first beta version of TrAgLor started to serve on August 8th, 2007 and submitted to Google search engine. As can be understood from the statistics in Table 2, total singular visits were above 229,076 within a period of 10 months although no comprehensive presentation or announcement has been made. This means that the repository has been visited 23,000 times monthly and 800 times daily as confirmed with the statistics given in Table 2. The statistics on number of visitors confirm that there is/was a high interest and need for domain specific repositories in agriculture.

Currently, there are 486 metadata files and 209 local objects in TrAgLor's repository system. As can be analysed in Table 1, totally 486 objects have been viewed 51,800

times, and hits average has been 106 per object. Just opposite to the expectations, it is seen that the users were not interested in metadata view as much as they did for the objects views. The hits for metadata views have been recorded as 24,082 with an average 56. As understood from Table 1, the hits for metadata views were nearly half of object views, and indicated that users were not familiar with metadata concepts yet as we expected.

TABLE I
OBJECTS AND METADATA USAGE STATISTICS

Statistics	Value ¹
Total number of metadata files	486
Total hits for objects view	51,800
Average hits for objects view	106
Total hits for metadata view	24,082
Average hits for metadata view	56
Total number of TrAgLor local objects	209
Total hits for TrAgLor local objects	24,505
Average hits for TrAgLor local objects	117

¹as at 31.5.2008

TABLE II
VISITOR STATISTICS

Period/Time	Visitors (Singular)
Instantly (31.5.2008 at 23:00)	22
Daily (31.5.2008, at 23:00)	1,245
Monthly (1-31.5.2008)	51,378
Total (8.8.2007-31.5.2008)	229,076

TrAgLor is a "metadata repository" for referencing external objects it is also "object repository" system for the objects developed by its users and content providers. The objects submitted to TrAgLor are called as TrAgLor local objects and marked a green icon of TrAgLor in search results and list pages. The number of TrAgLor local objects in the repository was 209 as of May, 2008. When the usage statistics of TrAgLor local objects compared to all metadata it has been found out that they were in more demand because they have been visited 24,505 times totally (avg. 117 times per object) as of the last week of May, 2008. The fact that this value is higher than the general average hits for all objects. This was probably happened due to demand for the objects in local language because the users mostly from Turkey. The second reason was that reusability design approach applied to the local objects of TrAgLor. Another conclusion to draw from this fact is that if high quality and reusable objects are offered via repositories, a significant object economy can become a reality.

The most of TrAgLor's local objects have been created and/or submitted by the project administration for demonstration purposes, but after an announcement posted in the end of December, 2007 different learning objects which can be used in different branches of agriculture, food,

environment, and veterinary disciplines have been added and uploaded by the member users. At the present time, however, TrAgLor local objects are being developed and/or collected by TrAgLor administrators and some member designers, they will be created by the registered content providers and graphical designers in the future. This sort of objects will be regarded as "featured object", and will be managed with the digital rights management subsystem in the forthcoming versions of the repository.

VI. CONCLUSIONS AND FUTURE WORK

In e-learning, whilst the inadequacy of quality learning objects is one of the most fundamental problems on one hand, finding the existing objects is another difficulty on the other hand. In this respect, TrAgLor can be seen as one another repository implementation toward accessing the agricultural learning objects and/or educational resources. Beyond serving domain specific objects for agriculture and related life sciences at <http://traglor.cu.edu.tr>, it also exemplifies some innovative and helpful approaches with its certain design and content features:

--Random image push with descriptive tip texts as the banners at top of the pages changing in every page access. In this way users can learn via them while they searching in a aesthetic visual environment.

--A rich options set of alternative search, browse and listing operations (i.e. simple, advanced, LOM elements, full text). With these wide variety of search options user can find and access the objects in their preferred styles.

--Various view styles for showing object and metadata. Users can see metadata of object in tabular view, list view, and xml view.

--Tree view editing tool for inserting and updating metadata. Using TreeLom enables users can create IEEE LOM compatible metadata, rapidly.

--Multilingual and multicultural user interfaces and learning content. TrAgLor also aimed itself to be of a global scale repository system rather than being a local one. It presents user interfaces, vocabularies and classification categories in Turkish, English and German at the present time.

--Light portal subsystem for news and events. In TrAgLor, users can read daily news for agriculture and food mainly. They can also view the agriculture related events compiled from the Web, constantly.

Although the majority of learning repositories in agriculture and related disciplines have usually been designed to use a specific application profile to organize metadata, TrAgLor can be referred as an IEEE LOM based repository for this domain in order to be ready to interoperability between different systems. Beyond this preference, since TrAgLor has been designed to use any sort of metadata standard or application profiles, non-LOM based metadata schemas can be also adapted into the system. To demonstrate such kind of metadata shifting methodology, in the future versions of the repository we plan to make some minor modifications in applications tier of it.

However, at the present time, TrAgLor uses USDA AGRICOLA category system for classification purposes this is not a restriction because shifting one category system to other is very simple task with it. Namely changing category map from AGRICOLA to AGRIS/CARIS is possible when the related category file is renamed as *categorymap.xml* in data space of the system. Although the current version of TrAgLor can concurrently use only one category map for classification purposes we also plan to incorporate a classification shifting algorithm as an option in future versions of it. With this shifting algorithm, all available classification systems will be listed in the input box for *taxonpath.source* element of LOM during metadata entry. Thus a user will be able to change the classification system to one which is familiar with him/her.

However TrAgLor has a reviewing subsystem for object evaluation by the editors, object adding and reviewing have been performed by the project administration during the development phase. Therefore, in that phase, the metadata in the repository have mostly not been examined in their educational features perfectly, but the technical features of them have been recorded in more comprehensive evaluations. In the future, we will develop some automated reviewing tool that will be based on a total index score for quality indicator of the objects. The total index score will be sum of the points which are given to certain technical and educational characteristics of an object.

In future versions of TrAgLor, in addition to the best practices and guides which will exemplify the usage of LOs by e-learning systems we also planned to develop some authoring tools to build LOs in the repository internally. Web based tools to author; link and package the learning content for different LMS/LCMS systems are some of examples of them, will be available with forthcoming versions of the repository. Currently, also we are working on a digital rights management subsystem to promote the participation of academic staff to the system.

Consequently, as modified and improved, TrAgLor will be likely to contribute to the e-learning applications, becoming widespread and create a capacity enlargement effect in terms of content and design. Although it is clear that the usage and contribution level of the academy, students, extension services and farmers will be an important determining factor regarding its sustainability, it is hoped that it will contribute to the enhancement and use of the quality learning resources in e-learning applications for agriculture education at national level.

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