Research Article

Semantic Ontology-based E-learning Framework for Heterogeneous Environment

V. Geetha[1], Saad Saeed Alamry[2], M. V. Srinath[3]

[1]Department of Computer Science, STET Women's College, Thiruvarur, Tamil Nadu, India, [2]Department of Computer Science, King Khalid University, Abha, Saudi Arabia, [3]Departrment of MCA, STET Women's College, Thiruvarur, Tamil Nadu, India

ABSTRACT

E-learning is concerned with providing simple access to learning resources, anytime, anywhere, through depository of learning resource which is effectively used for education and training. E-learning is implemented for the purpose of enhancing interaction in union systems to support all critical functions in one package. Ontology is defined as the specification of concept, which is the main component of semantic web (SW), which is practiced in Moodle-(learning management system) platform. The E-learning content focuses only on single province ontology. The major complication in data extraction is lack of heterogeneous web services discovery. Hence, the heterogeneous based E-learning framework is used, which efficiently handles and acquires all kinds of web contents and complex query data processing. The annotate on E-learning Moodle algorithm is handled to develop the SW learning. The proposed protégé ontology web language (OWL) and Wiki which is the extension of protégé plugin comprises ontology and (OWL) rules. Thus, the heterogeneous framework for E-learning is incorporated from different provinces and was based on SW rule language.

INTRODUCTION

E-learning is an instructional program that uses the qualities and assets of the web to make an important learning condition. E-learning is only the coordination of the conventional computer-assisted instruction or computer-based training into web innovation.[1] E-learning has been a hot creative work locale. The main objective of E-learnin-g is both open source opportunity and classroom. There are various E-learning on the internet; however, they give only a comparative plain hypertext page to all understudies. E-learning circumstances may add to the training and learning process if the mix is done inside the structure of proper instructing technique. Building changed E-learning programs put levels of ubiquity on the arrangement, programming aptitudes, and time. A differentiating choice to this can be an association of courses inside learning organization structures which are shown in Figure 1. Learning management system (LMS) range from systems for directing the planning and enlightening records to programming for spreading on the web or blended/cream school courses over the internet with features for online joint exertion. Colleges, universities, and school semantic web (SW) obtained from World Wide Web Consortium (W3C) were Tim Berners-Lee's had introduced the W3C concept. From his vision of web has a worldwide medium for exchanging and sharing of information and knowledge.[2]

The second generation web (Web 2.0) is the source product for SW that builds the web itself to understand and satisfy the request of user and web agent to use the web content.[3] Using formal semantic, the suitable content for an automated system to employ adverse to the proposed content for human consumption and also enable to the automated agent to reason about web content and produce an intellectual response to abrupt situation. The entry point of SW in E-learning as the knowledge resource get shared and distributed to various locations as the websites drive to the requirement for web system. These SWs provide for accessing a collection of URLs which search for information.

Semantic search improves recent search engine with semantics which goes beyond frivolous keyword matches by accumulate semantic information, thus admitting simple removal of irrelevant data from the result set.[4] SW focus to have data distribution and services linked and defined in such a way which they can be used by machines as automated, integrated and also to reuse information and services across several applications.[5] Some of the SW functions are listed below.

- Automatic web service discovery is an automatic finder of web service locations which provide individual functions.
- Invocation is involvement of automatic execution of recognized web services.

- Monitoring helps user or administrator to know the web service status once it gets processed.
- Composition involves in automatic and interoperation of web services to execute several tasks using this function for several recent activities may be composed automatically without programming. The major task for the SW is "expressing meaning." To accomplish that objective, many layers of representational structures are required.

They are represented in Figure 2,[6] the following layers are the basic architecture.

- XML layer is represented for the data structure.
- To represent the meaning of data, resource description framework (RDF) layer is used.
- To represent the formal general agreement about the meaning of data, ontology layer is used.
- To enable the meaning of data with intelligent reasoning, the logic layer is used.

The SW bases are resources which are identified through their unique resources identifier or internationalized resources identifier. The next layer of SW is XML which has set of syntax rule for creating semantically rich markup language in a specific domain included with it namespaces.[7] It is a mechanism for creating unique names globally for the element and attributes of a markup language to avoid a vocabulary conflicts. Next to the XML is the RDF which made an XML language to describe whole resources.[8] One such framework that has been step by step increasing overall notoriety is modular object-oriented dynamic. E-learning creates a revolution in learning process area which can benefit from SW technologies. The recent approach of E-learning introduced the teacher-student model, in this model students are presented with material and then tested to assess their learning. Even though, the framework of E-learning should take advantage of semantic services, ontologies, semantic annotation, and interoperability. The recent emergent of SW technologies such as discussion and annotation tools shows that E-learning system would offer more flexibility in SW.[9,10] The major properties in the architecture of SW enable the set of suitable agents, organize a powerful approach to fascinate the E-learning requirement efficient, just-in-time, and task-relevant learning. Learning materials are annotated semantically and also for a recent learning demand which may be simple combined in a recent learning course. According to the preference, the user can able to find and combine useful learning material very simple. The ontological background of learning material enables the process based on semantic navigation and querying.[11] The learning object metadata is the learning resource which promises some rules would be described in the process of e-learning.[12]

At present years, ontology has been used widely in the web field and also information science particularly in a domain such as intelligent information integration, cooperative information system, knowledge representation, information retrieval and extraction, database management systems, and also more useful when are used in the domain of e-learning system (Moodle). However, ontology can also be used to support the specification of learning resources.[13] The extension of protégé is the protégé ontology web language (OWL) which supports OWL there are several plugins available in Protégé. The recent improvement in standard ontology language is OWL that

endorsed by W3C to endorse the vision of SW.[9] The OWL includes description of properties, classes, and their instances. In the given ontology, OWL formal of semantic specify the logical consequence derivation that facts not totally based on ontology but required by semantic. The requirements may be single or multiple distributing documents which have been combined using OWL mechanism.

Problem Statement

The greater part of the current learning device gives a U-learning which is a sort of adapting anyplace, whenever and is in this manner intently connected with portable advancements. Since the clients are individual and do not impart at the same time, so it is hard to finish the undertaking. There is no substantially more connection between the learners and the mentor. Consequently, this is accessible in anyplace and it does not cooperate in gathering, so the data sharing is troublesome. Learner's communication is not simultaneous, but E-learning makes good use of database and content management system (CMS) technologies. Both database and CMS work simultaneously to store the content, of course, student record and test results. Using a database, data get stored, and the CMS serves as an interface to add, edit such as update the data and delete. LMS is an item application for the association, documentation, following, declaring, and
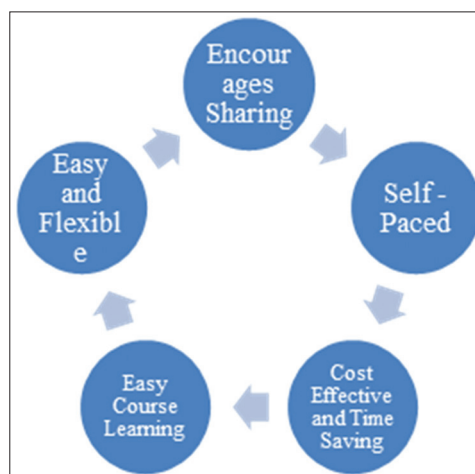

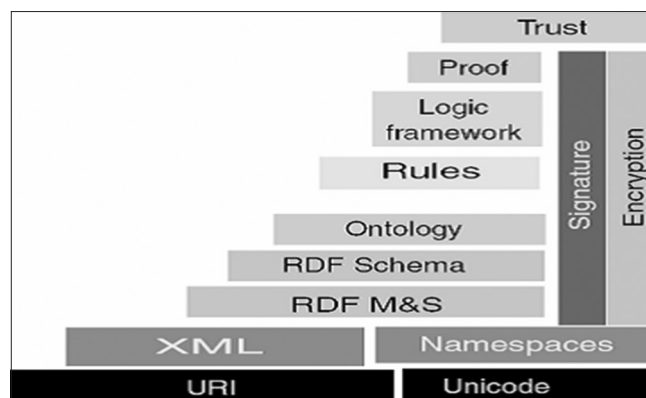
Figure 1: Benefits of E-learning

Figure 2: Layers of the semantic web architecture[6]

transport of electronic informative development (also called e-picking up) instructional classes or getting ready projects.[14] Even though there is lagging in real time example with logic study and discussion on course materials in the concept of straightforward. In this research protégé framework and OWL used to design the ontology for the open learning environment, enumerated the terms that can possibly found in the domain, then organized them in a hierarchy depending on which class subsumes another, and defined properties for each class.

RELATED WORKS

There are several researchers introduced ELS based on SW technology during past few years. Some of the authors[15-17] mentioned that SW is an essential technology implemented in ELS to solve several problems, starting from the representation of an area of learner's knowledge, the evaluation of knowledge level to the representation of domain in knowledge for developing an efficient association between the learner's need and the adequate learning resource. Samsuzzaman *et al.*[18] have proposed ELS based on SW technology such as OWL, RDF, and also XML which are used as appropriate for learning institution was the system include learning activity, course document, learning style, and teaching method. In the model, there are three users; administration, instructor, and learner the connection between the resources by ontology-based contextual knowledge (OWL). The system added ontology knowledge into learning resources because the resources can be searched by means of queries. The learning resources have described by means of metadata. Samsuzzaman *et al.*[18] concluded that the contents of the system have been arranged hierarchically and the relation in between the content is semantic. Therefore, this will help the student to find and search for information and learning resources in an E-learning system. Ghaleb *et al.*[19] presented ELS, in a new approach, based on the SW where RDF and OWL were used to develop the ontology. RDF is used for data modeling, while OWL is used an ontology language. The proposed model presented two types of contents; learning content and assessment content. Each content provides its own services such as course document, registration, online course, notifications (announcement), interactive tutorial, useful links, student paper, and semantic search. The assessment content is to evaluate the student knowledge (exercises and quizzes). The system allows the lecturer to create and manage his/her course. On the other hand, the metadata consists of the framing description of each learning object of a subject, i.e., the modularized content, which is linked to the concept of the ontology. Remote application platform (RAP) and application programming interface have been used in this system to convert the data to a set of RDF statements. The scenario of the system is the student will search for an online course then the result will satisfy the query. Otherwise, the student may find other courses that are interesting and can register for the course. In addition to that, the students and instructors were the main agents in this system. The classes and properties have been created using protégé 2000. To conclude, the presented system of e-learning uses an SW technology with different services and tools as well. Meta-data are used to present the model in a simple way. Added to that, users can search and simply figure out the required documents and other various services. However, some technologies were used to implement

the system such as PHP, MYSQL database, and RAP toolkit. Mukhlason *et al.*[20] investigated the emergence of SW and knowledge management to develop ELMS. In this system, an ontology approach has been used to develop the semi-automatic ontological knowledge base construction system and automated question answering system. The system has been implemented using Moodle. In LMS, the open source is Moodle, and it consists of three frameworks. The first framework is the ontological approach for learning.

Wiki is a tool for activity that aims to produce in a collaborative manner. This means that it requires no readymade and individualized answers Figure 3 shows E-learning system based on SW. The use of Wiki through Moodle, is a form of support to face-to-face learning, which contributes to collaborative learning, practicing, reading, and writing in groups by means of writing text. The tool provides the student with a very significant and E-learning process. Using Moodle, it was concluded that this tool to support face-to-face learning allowed the sharing of information in the virtual learning environment (VLE).[22] A viable end-to-end E-learning condition, which recognizes the key empowering influences for sensible E-learning foundation. The semantic framework combines the SW with lattice registering. It is a layered stack at each virtual organization (VO) with two noteworthy fragments.[23] The application for end-user such as courseware and group manager is carried out by SELF VO in the topmost layer. The user's applications are organized and independent by the SELF-component into a single framework is high due to interoperability. In this approach, there is a security lacking issue such as confidentiality of content and authentication of individuals.[24] The online video with synchronized slides is used from auto view presenter and also for configuring the video source and to set the time for slide trigger, a web-based editing interface is used.[25] The requirement of Macromedia flash movie is essential for auto view presentation to put together. It consists of video files and slides that can be progressive download from Moodle or buying streaming video server; video get to download as an alternate solution.

PROPOSED METHODOLOGY

Moodle (LMS)

The open-source for LMS or e-learning platform is Moodle which serves as educators and learners throughout the globe. The protégé-OWL is an extension of protégé that supports the OWL. OWL is the latest development in standard ontology languages, signed by the W3C to endorse the vision of SW. According to ontology engineering, there is a set of tasks which related to the advancement of ontologies for an individual or separate domain. The following steps in the methodology are given below.

Determination of scope in ontology based on domain

To determine the ontology scope of work is to list out the questions based on the knowledge base. It can able to answer the competency questions. Moodle is the open learning domain in which ontology requires details such as certain information to be answered, and whether the answer required particular levels of details or representation of particular area. Therefore, the information from the Moodle is essential for an

ontology which includes the details of the process. The type of information is listed below

- In Moodle, how to create a login and also to add the new user?
- To accomplish edit, perform bulk and delete action from the user
- To identify the Moodle user and enrolment of the user into courses
- To add or remove permissions from student, teacher, and other users in the Moodle.
- Identify the user who has the responsible to create and manage the model courses and also know which extend the Moodle user can able to deal with the course, activity, and recourses.

The above information helps to judge the scope of ontology which allows the user to login to the Moodle site based on their username and password. This types of Moodle users and process of assigning users to a role in an activity or course.

Evaluate the reusing existing ontologies

The reusing of existing ontologies is essentially required if the Moodle users interrelate with other application which has already committed to specific ontologies or controlled vocabularies.

Enumerate ket terms

Initially to get the complete list of terms is very essential, we have considered Moodle hierarchy as a example for open LMS to termed as various classes such as Moodle site, Moodle user, Moodle course, Authentication, admin, accounts, new users, role permissions, enrolments, courses, activities, resources, course creator, teacher, non editing teacher, students, guests, questions, user name, course name, password, course duration, student number, student name, hasauthenticates, hascreates, is createdby, hasenroles, hasmanages, helps, views, and so on. These are the listed terms in the Moodle hierarchy which helps to mention the classes and their properties Figure 4 represents the class Hierarchy and classes.

Define the properties of classes

After defining the classes, the internal structure of concepts is described. Already classes are selected from the above list of terms which had created in enumerate key term. The rest of the terms are possible to be a property of these classes. The list of terms which included is shown below:

- HasAuthenticates and its sub-properties are partial authenticates on and has full authenticates on.
- Hascreates.
- For hascreates, there is an inverse property named as is created by which.
- For hasenroles and its sub-properties are hasselfenrolesin and has manualenrolesin
- For has manages and its sub properties are has partial manage on, and hasfullmanageon.

The rest of property is termed as classes such as username, password, course name, course ID, course duration, student no, and student name. For each property in the list, we must determine which class it's describe. These properties become

slots attached to classes. Thus, Moodle user class will have the following properties: Hasauthenticates and its sub-properties are has full authenticates on belong to the admin as has partial authenticates on, belong to the course creator helps to belong to the on editing teacher, the student no and student name belong to the student, and views belong to the guest. Moodle courses class will have a course name, course id, course duration, hasCreates, and hasEnroles with its sub-properties are hasManualEnrolesIn and hasSelfEnrolesIn properties. Relationships to other individuals, these are the relationships between individual members of the class and other.

Define properties of properties

This step is to identify the properties and the properties may have a domain and specified range. Properties may have a domain and a range specified. Properties link individuals from the domain to individuals from the range. For example, in this ontology, the property hascreates would probably link individuals belonging to the class Moodle user to individuals belonging to the class of Moodle course. In this case, the domain of the hascreates property is Moodle user and the
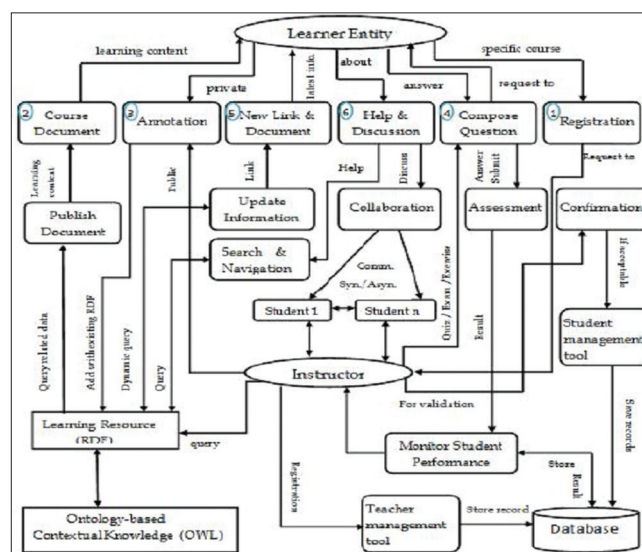

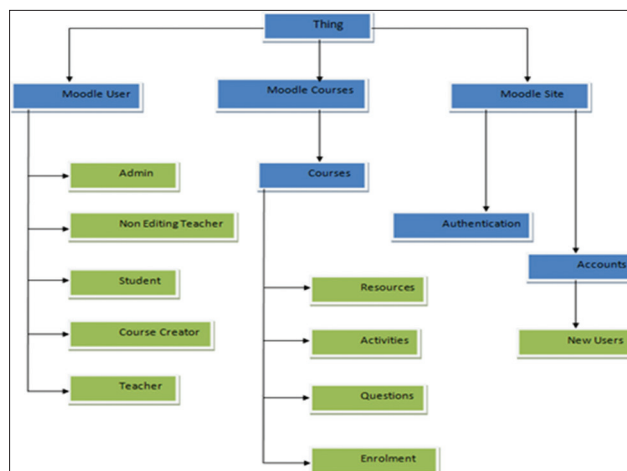**Figure 3:** E-learning system based on semantic web[21]

Figure 4: Moodle classes hierarchy

range is Moodle course this is depicted in Figure 5. It is an essential to realize that in OWL domains and ranges should not be viewed as constraints to be check and in reasoning "axioms" is used.

Create instances

At this stage, the ontology populates with instances of classes. For example, class courses may have instances such as database and software engineering. After finished designing the ontology and ensure that all classes are consistent and well defined, they can make queries using SPARQL. For example, Select *Where? Subject? hascreates ? Object and the result is shown in Figure. 6

Plugins

Plugin is a flexible toolset that allowing Moodle users to expand the features of the site. There are hundreds of plugin for Moodle to expanding the Moodle's core functionality features. Each plugin is maintained in the Moodle plugins directory. Moodle is a measured framework in view of modules, which resemble Lego obstructs that you set up together to manufacture whatever you need. There are modules for various types of substance, and modules for a broad range of community-oriented exercises, which is the place Moodle truly sparkles.

The plugin plays a key role in the Moodle; each one specifies the individual concept. Annotate is used as an instructor to a way for the instructor to engage with students, allowing meaningful discussions on course materials. This tool focuses on several mechanisms for learning that is based on semantically constrained annotation and independent as a specific implementation needed. This concept is straightforward. This E-learning goal is apparently so obvious to the students that they feel less need, leaving more time and effort form meaning oriented conversation. This orientation toward processing the meaning of the text is supported by the fact that students refer more to the content in the text and each other's messages.

Annotate on E-learning Moodle Algorithm

Annotate Lm ← New plug-in

Register R ← New R

For I= user1 → F.USER

//The initial user joined//

For N= N+1 → E. USER

F.USER→E.USER

//Comparing the user//

$this->title = get.string

("pluginname", "block_annotate")

function_ R ← configure

return →true;

//Tool implementing//

function C← c content()

global $CFG;

if ($this->content !== null)

return C

$this-> Content;

//No user assumed//

If → empty $this->Configure,

if $this ← configure->access == 'group' $this->content->text.= get →String "Configure G group →access",

("block -annotate");

$this->content C

//Empty data assumed in a tool assigning//

Get →String R

//Access share user message//

Block → Annotate. A

if ($this->configure->share user != ")

'Strings' => array ();

$arguments = array

'pdf- doc-xls-ppt-jpg',

$CFG → root R;

//Sharing the audio and pdf files to user//

if=>F.USER

$this->page->requires->js → call

'M. Block- Annotate → init',

$arguments ← false, $js=> module

Return← $this => content.

//Tool configuration with sharing of files//

Mathematical Calculation

First User F1.E1

et← learning time

f1.t ← et [N1 + Nn]

//learning time for the user//

Fn← et [mt]

[mt→ e1........en]

F1.t[e1+en]/2

et→ at [f1 + e1]

//approximate data shared to the user//

et is unequal to en

et← e1 +en/mt

//hence all data are shared to the user//

mt← en [et/2]

etnot equal to en

F1← first user.

F1 is not equal to Fn

//hence user may be increased//

RESULTS AND DESCRIPTION

This states the E-learning improvements in LMS; the annotate is used as an instructor to a way for the instructor to engage with students, allowing meaningful discussions on course materials. This tool focuses on several mechanisms for learning that is based on semantically constrained annotation and independent as a specific implementation needed. This concept is straightforward. Annotate is an excellent review and learning tool for Moodle. Using the learning annotation tool, students can draw over diagrams, pictures and educator annotations to check whether they understood correctly the concepts. After developing the ontology has been finished, it sends to the reasoner to check class consistency and to compute subsumption relationships. The reasoner generates inferred class hierarchy and the researcher ensures that all the classes are consistent with its own definitions. As result, have explicit representation and full definitions for Moodle objects, properties, and their relationships. And also can make any query to retrieve information. For example, we can make a query to know who can create courses or who has full authentication right or who can help students and so on.

After the reasoner has been invoked through the "start reasoner" button in the reasoner drop-down menu - to automatically compute the classification hierarchy, and also to check the logical consistency of the ontology, inconsistent classes appeared, and Reasoner stopped working. After several times to fix this mistake, the researcher found out that it was due to logical mistake, "has self enrole" property defined to be functional and transitive at same time Figure 7. The inconsistency fixed, and the reasoner invoked once again. The inferred hierarchy has been computed, and an inferred hierarchy window popped on top of the existing asserted hierarchy window. Figures 8 and 9 display the difference before and after invoking the reseaoner.

Data sharing

The main function of E-learning is to share the data from anywhere in the form of audio, video, and pdf file. The following screenshot demonstrates the file sharing on learning to the users from the mentor which is available from anywhere to the user on the compact ability. Figure 10 shows data sharing on E-learning.

Data monitoring

The following screenshot states the process of monitoring the video by the user, from where ever they available at any time without any cost. This is more useful to the user since it makes them more comfortable and easy to learn. Figure 11 shows user to view on E-learning.

Wiki

Wiki is a tool for activity that aims to produce in a collaborative manner. This means that it requires no readymade

and individualized answers. The use of Wiki through Moodle is a form of support to face-to-face learning, which contributes to collaborative learning, practicing, reading, and writing in groups by means of writing text. The tool provides the student with a very significant and collaborative learning process. With the use of Moodle, it was concluded that this tool to support face-to-face learning allowed the sharing of information on the VLE. On comparing these two tools, there is a proper clarification that annotates tool is more efficient to the user.
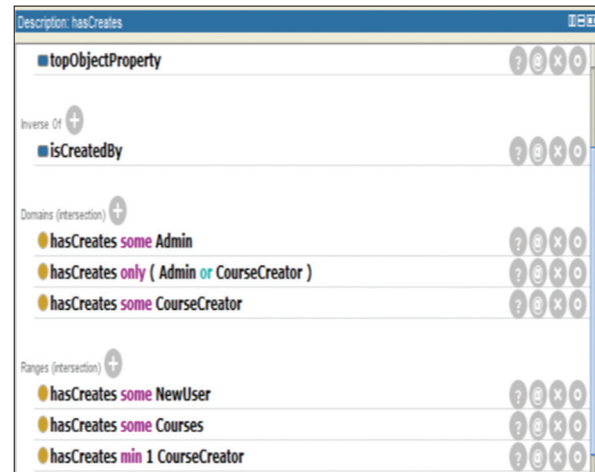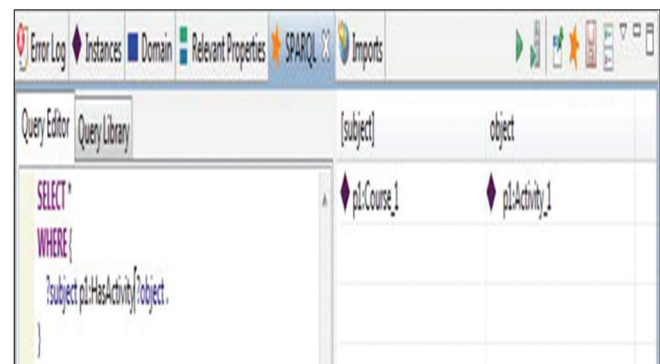

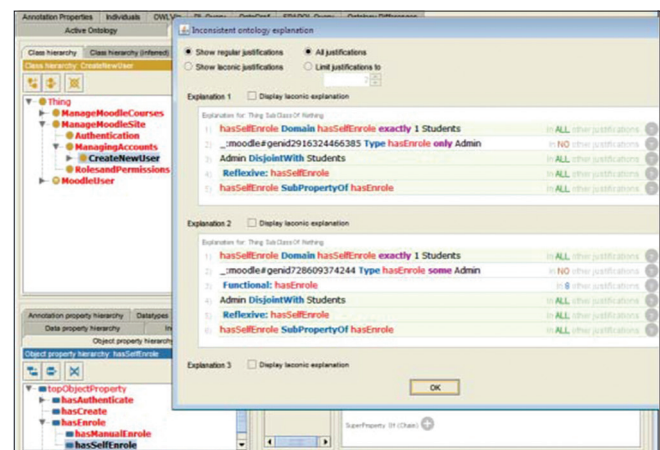**Figure 5:** Object restriction

Figure 6: Query using SPARQL

Figure 7: Inconsistent classes and ontology explanation

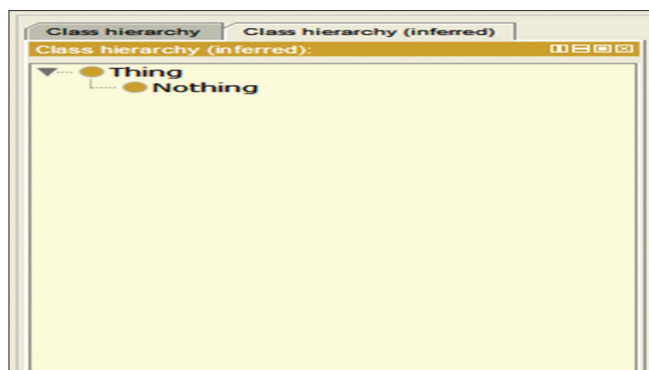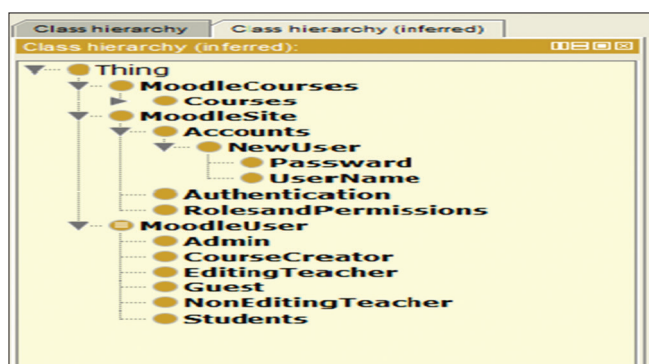**Figure 8:** Inferred class hierarchy before invoking the reasoner

Figure 9: Inferred class hierarchy after invoking the reasoner

Figure 10: Data sharing on E-learning

Figure 11: User view on E-learning

CONCLUSION

In this research Protégé Framework and OWL used to design the ontology for the open learning environment, enumerated the terms that can possibly found in the domain, then organized them in a hierarchy depending on which class subsumes another, and defined properties for each class. After that, the steps went deeply to define constraints on the properties such as cardinality constraints, domain, and range constraints. The final step in designing the ontology was defining some instances to be able to make queries, due to the advancement of new emerging technologies and development; there is simultaneous communication between the learners and the mentor. This advanced E-learning system improves the students bonding with one another. Their use caused both the instructor and students to realize their roles in the course and behavior in the classroom had to change significantly. In this learning environment, E-learning plays an important role. After that, the reasoner used to check the consistency of the classes and to generate inferred class hierarchy.

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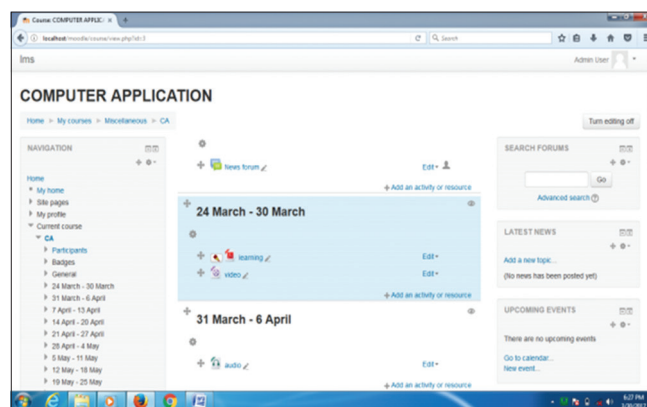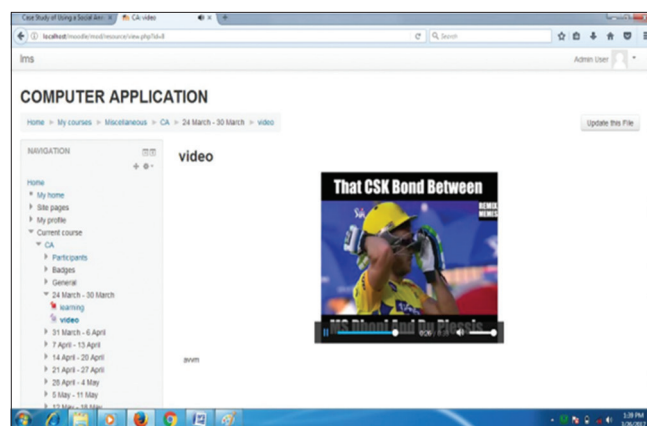4. Ameen A, Khan KU, Rani BP. Creation of Ontology in Education Domain IEEE Fourth International Conference on Technology for Education. Available from: http://www.AyeshaAmeen. [Last accessed on 2015 May 01].
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