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Applying Semantic Web Technologies to Services of e-learning System

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Abstract: *Although of the semantic web technologies utilization in the learning development field is a new research area, some authors have already proposed their idea of how an effective that operate. Specifically, from analysis of the literature in the field, we have identified three different types of existing applications that actually employ these technologies to support learning. These applications aim at: Enhancing the learning objects reusability by linking them to an ontological description of the domain, or, more generally, describe relevant dimension of the learning process in an ontology, then; providing a comprehensive authoring system to retrieve and organize web material into a learning course, and constructing advanced strategies to present annotated resources to the user, in the form of browsing facilities, narrative generation and final rendering of a course. On difference with the approaches cited above, here we propose an approach that is modeled on narrative studies and on their transposition in the digital world. In the rest of the paper, we present the theoretical basis that inspires this approach, and show some examples that are guiding our implementation and testing of these ideas within e-learning. By emerging the idea of the ontologies are recognized as the most important component in achieving semantic interoperability of e-learning resources. The benefits of their use have already been recognized in the learning technology community. In order to better define different aspects of ontology applications in e-learning, researchers have given several classifications of ontologies. We refer to a general one given in that differentiates between three dimensions ontologies can describe: content, context, and structure. Most of the present research has been dedicated to the first group of ontologies. A well-known example of such an ontology is based on the ACM Computer Classification System (ACM CCS) and defined by Resource Description Framework Schema (RDFS). It's used in the MOODLE to classify learning objects with a goal to improve searching. The chapter will cover the terms of the semantic web and e-learning systems design and management in e-learning (MOODLE) and some of studies depend on e-learning and semantic web, thus the tools will be used in this paper, and lastly we shall discuss the expected contribution. The special attention will be putted on the above topics.*
Keywords: *Semantic Web, Ontologies, Moodle, E-learning.*

I. Introduction

E-learning is an alternative concept to the traditional teaching system and offers new methods in learning. Thus, a student can get immediate feedback on solution to problems; the learning ways can be individualized, and so on. E-learning is a growing knowledge effortlessly because the number of courses available on the Internet. Thus, the organizations is working on this learning is growing rapidly. [1].

There are many e-learning systems such as Module Object Oriented Development Learning Environment (MOODLE), is an open source Content Management System (CMS) designed on base of social constructivism. And has modular design that makes it easy to create new courses, adding content that will engage learners. This modular object-oriented dynamic learning environment possess intuitive interface that makes it easy for teachers to create courses [2]. MOODLE has been applying in the universities to allow the use of new methods of E-learning and encourage the self-learning. This application allows the generation of a specific space in which students and teachers can interact in order. The student can also have some tools to assess its level of knowledge through quizzes, exercises. In order to encourage the collaborative work, the possibility of generating forums, wikis or workshops exists [3]. But we find despite of all these features, this system lacks many of the features that make it a sophisticated and up to date with developments in the web as semantic web technologies, ontology and that may make it more flexible in terms of usage.

The Semantic Web is arising vision of new web technologies aiming that information and services that would be understandable and reusable by both humans and machines. It wills expect the semantic web technologies influence the next generation of e-learning systems and applications. And ontologies are a major component of the semantic web, generally defined as a representation of a shared conceptualization of a particular domain. To take the development and widespread e-learning contents of semantic web applications a step further, we have developed a Learning Management System (LMS) based on an infrastructure entirely designed using the technologies made available by the semantic web, namely XML, RDF, OWL, SPARQL[4].

LMSs are becoming increasingly popular now; well-known LMSs include MOODLE, whose focus has centered on distance education opportunities. Typically, MOODLE includes a variety of functionalities, such as class project management, registration tools for students, examinations, enrolment management, test administration, assessment tools, and online discussion boards [5].

The most serious problems are caused by didn't used the semantic processes. Current platforms may be helpful to acquire tacit knowledge in organizations, but they do not solve the problematic of doing automatic semantic information. Thus, cooperative cognitive processes are not efficient and not found accurate search to exact information on the system matching with the requested data. In fact, when we are using the semantic web in MOODLE can be lacking for these problems. Thus, the augment of students per LOs can dedicate to each student. This makes the learning process to be very easy.

By bringing together the previous statements and the need for a good way in the cooperative learning, we spot the need for tools supported by web techniques. A possible solution might include ontology components of semantic web technologies to deal with this issue. Some authors [6] utilize ontology based semantics to improve the analyses of information in unstructured documents. The domain ontology is acting a central position as a resource structuring the learning content [2]. One of the key challenges of the construction process is to identify the information abstract domain within which that will exist. The tutor has to describe the main terms and concepts from which a learning object is to be constructed.

In this paper we have developed is part of the MOODLE and explores the use of semantic web technologies to develop and discover modern Semantic Learning Management System (S-LMS). The S-LMS lead to complete information and management solution for MOODLE. Our focus to main objective is applying some technologies of semantic web to automate and accurate searching information on the system involved when students register for learning courses. Because managing a large course it’s a complex task. Many factors may contribute to this complexity, such as a large number of students, the variety of rules that allow students to register for a particular course, students’ background, and students’ grades.

The author has developed a solution that allows primitive users to discover resources which are more relevant to their learning context, i.e. their own application depends on domain ontology. These technologies of semantic web facilitate a discovery of resources in the remote repositories by mapping learning context to the remote ontologies on the web. In this way users’ search queries are contextualized behind the scene. Then we analyze the main system requirements and outline our approach to describe the representation and diagrams, we developed for applying ontologies. In the lastly we will have an example of the MOODLE system included of some web pages and we described it to how are developing to motivate our work. And we conclude the present and discuss the evaluation results.

II. The Objectives Statement

1. Used the semantic web technologies on the e-learning system to enhance and develop operation of search and interoperability. That lead to learner centric educational architecture, interest based knowledge retrieval, achieving reusability, and achieving semantic interoperability.
2. Letting learners search learning resources based on semantics, thus making it easier to search their targeted knowledge.
3. Improving context-aware semantic e-learning environments by providing semantic models for context modeling.
4. Personalized content is determined by the individual user’s needs and aims to satisfy the needs of every user.
5. Develop effective e-learning system (MOODLE) to customize and individualize. In this process ontology and metadata can play a critical role.
6. Allows students to know their learning flaws and helps teachers to design learning contents adapted to the needs of the students to find the appropriate learning materials in which they would need to learn, and distributed content comes from the interaction of the learners’ participant.
7. Hyperlinked course material allows learners to follow any navigational path they choose and not necessarily use the structure determined by web site designers or content creators (who have a certain navigational pattern in mind). Pull student determines agenda, and interactive responds to problem at hand.
8. Defined methods in coding have been developed in MOODLE to obtain an RDF fact base from the MOODLE content and to empower it with rules. Rules add flexibility to the content analysis and give more control to tutors over the courses and teaching process.

III. The Methodology

In the early stage of this paper, we make an observational study to analyze many constraints of teachers consider in the MOODLE learning system context as a specific learning position, determined by the learning activity, learning content, and the group of learners involved. We studied the possible students’ needs that can be relevant to forming different types of methods by investigating the available resources on collaborative learning theories [7], and asking teachers about the constraints they employ for different learning goals. We then gave some students to deal with the data they provide for the system and their satisfaction with the users at the end of course. Therefore we included instructors and designers from Sudanese universities such as developers, researchers, and instructional designers. Most participants completed the survey, each providing highly informative comments. Among other important findings, all observation for participants reported a lack of using the semantic web technologies on e-learning systems. We consider feedback to be information about observed learners' interactions either with learning content or with other participants in the learning process. We determined the feedback based on the responses we received from the observation at: the detection about the content that is difficult for students to search and understanding, identification of student difficulties to resolve, and identification of frequently problems.

The study enabled us to comprehend the depth of the problem and learning issues that guide it. Then we are forming and modeling the problem as a constraint satisfaction to be implemented as the semantic (system formation) MOODLE [8]. We also reviewed the different technologies of the web for developing system formation, and provided a model for the formation quality system in terms of the formation goals and hence the constraints satisfaction. And later on, we started implementing the system formation based on the following:

a. **GUIs:** Graphical User Interfaces can permit to user enter their data through a system pages form composed of the user's personal data, a list of other students, their interests and preferences, and information about their course such as the modules they are taking.
b. **The Ontology:** We created an ontology profile to description of a large range of student's and academic data such as learning styles and collaborators. We also use the trust ontology[9] to allow the students to rank their trust towards each other in specific topics. That idea of James Hendler in reusing and sharing a few ontological components instead of large complex ontologies[10], we propose to improve our learner profile and learning resources with more features by employing other domain ontologies (competency and interest topics ontologies). Once the student submits the profile data through the interface, an RDF file will create and processed using semantic web technologies to enhance the search engine.

To deploy our ontologies we have adopted the major ontology language, OWL (OWL 2004). The development of an ontology-driven application typically starts with the creation of an ontology schema. Our ontology schemas contain the definition of the various classes, attributes, and relationships that encapsulate the learning objects that method can be used at university. After conducting an analysis of ontology editors, we have selected model to construct our ontologies. Since the objective of Semantic Content Management System (S-CMS) application was to develop a system which provided the ability to a student register in a course projects, the inference over OWL documents needed to answer to questions which included:

- Who are the teachers and students?
- What courses are offered by a department?
- Which courses are assigned for a specific teacher?
- For which courses a student is registered?
- Which projects are assigned to a course?
- What are the students' grades of taken courses?

IV. E- learning Systems

The most systems form of e-learning on the web today is through Learning Content Management Systems (LCMS), such as MOODLE. It is a broadly adopted technology that enables setting up online courses and managing the students' activities. In particular, LCMSs provide instructors with substantial support for numerous activities indispensable for securing high quality e-learning processes, such as preparation of learning content, structuring and organization of the content in accordance with the chosen teaching strategy, interactions with coordination of students' activities using online communication tools, that allows learners to collaboratively create and share knowledge, by adding highlights, tags and notes in learning content. The information coming from peers, for instance, how other students have tagged or commented a piece of learning content, is seen as an important factor in increasing students interest in course topics [11].

Even though state-of-the-art LCMSs successfully support a huge set of online teaching/learning activities, their support for adaptation of learning courses is very rare. This is due to the fact that support for adaptation of e-learning materials is much trickier and less straight forward; hence widely used LCMSs enable only simple content editing features for this purpose. However, instructors need much better support since they have to almost constantly adapt their courses both in terms of the included materials and the applied instructional design. When doing this, instructors have to take into account students' performance and interaction with learning content in order to better address the specific needs and requirements of each particular students group, and thus secure students' high performance and learning efficiency levels.

Learning control needs the comparison between the learner's knowledge base, which is modified as the learning process evolves, with the course domain knowledge base. It requires for powerful and interoperable tools of knowledge representation and analysis. A structured information representation is then required. For it, semantic domain information can be used as they provide for flexible and extendable properties to knowledge manage-ment systems. The motivation for developing reusable atomic learning components and to capture their characteristics in widely-accepted, formal metadata descriptions will most probably attract learning object providers to annotate their products with the accepted standards.

The goal of the early software tutoring systems was to build user interfaces that provide efficient access to knowledge for the individual learners. Recent and emerging work focuses on the learner control over the learning process such as learner exploration, design and construction. For it, adaptive systems are used as tools [12]. With the application of more and better computer techniques in education and the involvement of more adults in software tutoring systems, the learner control strategy has become more appreciated than tutor or program control.

An important component of e-learning is students' knowledge and LOs preference. One of the main problems for the creation of matching systems is interoperability, i.e. the opportunity to reuse this knowledge in different processes. To organize knowledge exchange between various events, it is necessary to create some universal format of knowledge's preservation and their processing instructions. An important requirement for this format is that it should be platform independent. Standardization of educational technologies and, in particular, formats of match data preservation is being worked out all over the world.

V. MOODLE Platform Architecture

Module Object-Oriented Dynamic Learning Environment (MOODLE) is an open source Content Management System (CMS) in which activities are at the heart of the system. MOODLE was designed on base of social constructivism. Constructionism asserts that learning is particularly effective when constructing something for others to experience. The students could be considered as actively engaged in making meaning. Teaching with that approach looks for what students can analyze, investigate, collaborate, share, build and generate based on what they already know, rather than what facts, skills, and processes they can parrot. MOODLE has modular design that makes it easy to create new courses, adding content that will engage learners. This modular object-oriented dynamic learning environment possess intuitive interface that makes it easy for teachers to create courses. Teachers and students require only basic early acquired from Internet browser skills to begin learning, which makes last one very simple and user-friendly platform [2]. MOODLE has been applying in the universities to allow the use of new methods of e-learning and encourage the self-learning. This application allows the generation of a specific space in which students and teachers can interact in order to:

- Exchange experiences and the generation of debate forums about any topic of the subject.
- Resolve problems and exercises along the course.
- Allow an early evaluation of the teacher.
- Self-evaluate their own works.
- Set out new problems and obtain the collaboration of the community.
- Access to activities of any subject in any moment in base to its availability.

The student can also have some tools to assess its level of knowledge through quizzes, exercises. In order to encourage the collaborative work, the possibility of generating forums, wikis or workshops exists [3].

We have taken the proposed Semantic Web Ontology as a part of a typical MOODLE platform. In this architecture(fig.1) the component, user & course manager is responsible for capturing user interests, giving access to learning objects for learners, matching user profiles with the learning content and selecting the learning content satisfying the user interests. The assets and SCO manager is used by the authors to create SCOs using assets and other SCOs by the teachers to create new units and courses, the ontology manager is used by the author or administrator to update and improve the ontology.

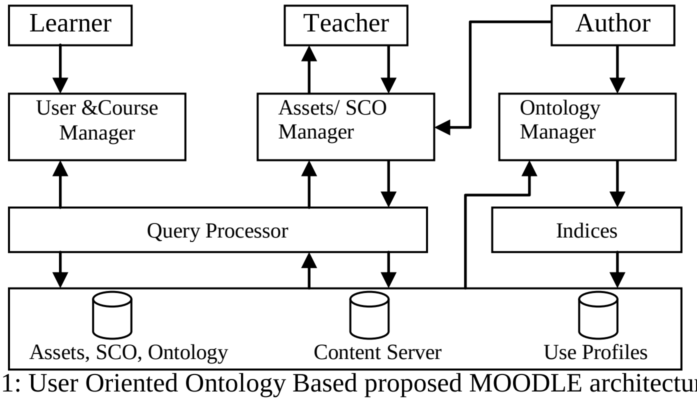

Figure 1: User Oriented Ontology Based proposed MOODLE architecture

The query processor helps to pass queries coming from the learners and teachers to the learning repository and to retrieve results of queries and pass them back to learners. Indices are defined on metadata to increase the efficiency of queries.

VI. The Semantic Web

Semantic Web (SW) derives from W3C director Tim Berners-Lee's vision of Web as a universal medium for data, information and knowledge exchange [13]. The word semantic web is a product of Web2.0 (second generation web) which makes the web itself to understand and satisfy the user requests and web agents or machines to use the content of web [14]. With formal semantics, it means the content suitable for automated systems to consume contrary to the content intended for human consumption. This enables automated agents to reason about the Web content, and produces an intelligent response to unforeseen situations.

A semantic web in e-learning system can be seen as an entry point to knowledge resources that may be distributed across several locations, as the web sites led to the need for web systems, sites providing access to collections of interesting URLs (i.e. keyword-based) search for information. Otherwise, differently from URLs web systems, semantic web in e-learning are "smarter" and carry out intelligent reasoning behind the scenes. They should offer semantic services including semantics-based browsing, semantic search and smart question answering. Semantic browsing locates metadata and assembles point-and click interfaces from a combination of relevant information [15] [16]. Semantic search enhances current search engines with semantics: it goes beyond superficial keyword matching by adding semantic information, thus allowing easy removal of non-relevant information from the result set. Semantic web aims to have distributed data and services defined and linked in such a way that they can be used by machines not just for display purposes, but for automation, integration and reuse of data and services across various applications [17].

Some functions of semantic web are described as follows:

- Automatic web service discovery: automatically finds the location of web services that provide a particular function.
- Invocation: involves the automatic execution of an identified web service.
- Monitoring: helps users or administrators know the status of a web service once it is invoked.
- Composition: involves the automatic composition and interoperation of web services to perform some tasks. With this function, some new activities can be composed automatically without programming. "Expressing meaning" is the main task of the Semantic Web. In order to achieve that objective several layers of representational structures are needed. They are presented in the figure2 [18], among which the following layers are the basic ones:
  - XML layer, which represents the structure of data.
  - RDF layer, which represents the meaning of data.
  - Ontology layer, which represents the formal common agreement about meaning of data.
  - Logic layer, which enables intelligent reasoning with meaningful data.

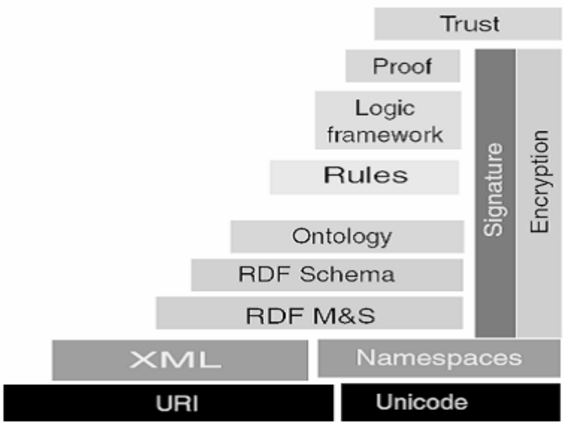

Figure 2: Layers of the Semantic Web Architecture [19]

The bases of semantics are resources, identified via their Unique Resource Identifier (URI) or Internationalized Resource Identifier (IRI). The next semantic layer is the XML, a set of syntax rules for "creating semantically rich markup languages in a particular domain" [20], together with its namespaces (a simple mechanism for creating globally unique names for the elements and attributes of the markup language", to avoid vocabulary conflicts). On top of XML is the Resource Description Framework (RDF), simply put, an XML language to describe whole resources (as opposed to only parts of them, as with XML). RDF Schema is a language that enables the creation of RDF vocabularies; RDF Schema is based on an object-oriented approach [21].

VII. Relation between E-Learning System and Semantic Web

E-learning is an area which can benefit from Semantic Web technologies. Current approaches to e-Learning implement the teacher-student model: students are presented with material (in a limited personalized way) and then tested to assess their learning. However, e-learning frameworks should take advantages of semantic services, interoperability, ontologies and semantic annotation.

The semantic web could offer more flexibility in e-learning systems through use of new emergent semantic web technologies such as collaborative/ discussion and annotations tools [22].

The main property of the Semantic Web architecture i.e. (common-shared-meaning and machine-processable metadata), enabled by a set of suitable agents, establishes a powerful approach to satisfy the e-Learning require-ments: efficient, just-in-time and task relevant learning. Learning material is semantically annotated and for a new learning demand it may be easily combined in a new learning course. According to his/her preferences, a user can find and combine useful learning material very easily. The process is based on semantic querying and navigation through learning materials, enabled by the ontological background [23].

The e-learning sphere of influence promising some new rules which would describe the learning resources, including learning objects metadata. Learning Object Metadata (LOM) is regularly [24]. Fetching the standard for the management of education systems and learning objects of various kinds. So the teaching materials for students must deal with a specific theme in various ways such as video training and learning games. By these students tend to attract a starting material for learning and can get a clear direction for their courses, particularly in distance learning studies.

The largest and main part of the Semantic Web in e-learning is a field of ontology, which should give a proper explanation of a concept of shared domain [19].

The Semantic Web can be exploited as a very suitable platform for implementing an e-learning system, because it provides all means for e-learning: ontology development, ontology-based annotation of learning materials, their composition in learning courses and (pro) active delivery of the learning materials through e-learning portals [23].

VIII. The Ontology

The term ontology has been widely used in recent years in the web field, and information science, especially in domains such as cooperative information systems, intelligent information integration, information retrieval and extraction, knowledge representation, database management systems, and also more useful when are used in domain of e-learning system (MOODLE). Many different definitions of the term are proposed. One of the most widely quoted and well-known definition of ontology is Gruber's [25]: Ontology is an explicit specification of a conceptualization [26]. However, ontologies can also be used to support the specification of learning resources [27].

Thus allowing not only 'static' interoperability through shared domain conceptualiz-ations, but also 'dynamic' interoperability through the explicit publication of competence specifications, which can be reasoned about to determine a particular semantic web service is appropriate for a particular task [32].

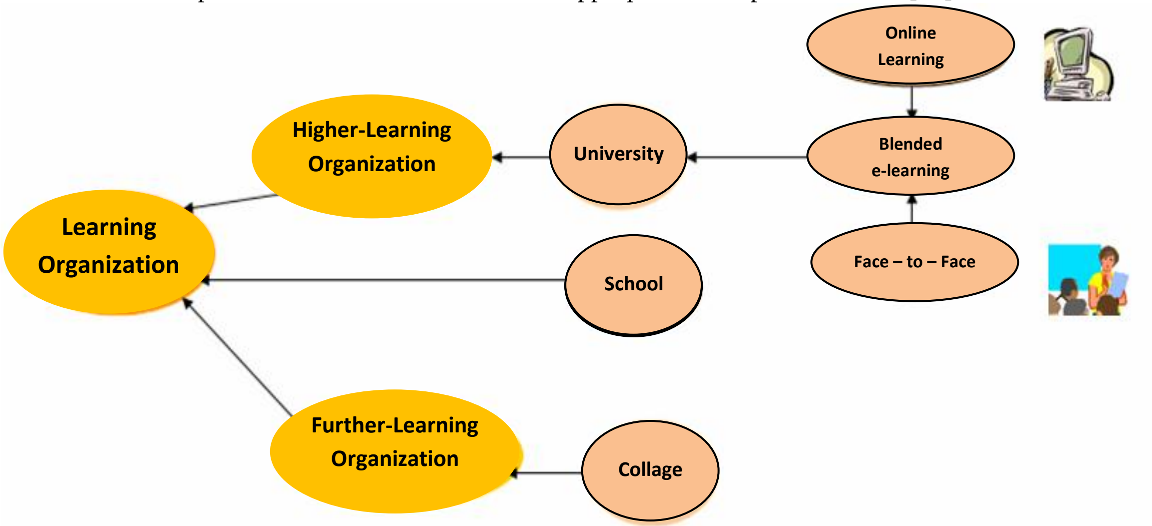

Figure 3: Blended e-learning Ontology: Educational-Organization

Ontologies can be used in Blended e-learning (online and face-to face interaction) as a formal means to describe the organization of universities and courses and to define services.

An e-learning ontology should include descriptions of educational organizations (course providers), courses and people involved in the teaching and learning process.

The ontology is one technologies of the semantic web, it can be described as an explicit specification of a shared conceptualization, which can be taxonomically or axiomatically based [29]. Ontologies can be based around a single taxonomy or several taxonomies and their relationships [30]. Taxonomies consist of concepts and relationships that are organized hierar-chically and whose concepts can be arranged as classes with subclasses.

The structure of ontology should be based on a taxonomy that allows for the modeling of a system based on certain functional descriptions [31].

The ontology can formulate a representation of the learning domain by specifying all of its concepts, the possible relations between them and other properties, conditions or regulations of the domain. The development of the ontology is similar to the definition of a set of data and their structure. In this way, the ontology can be considered as a knowledge base that is used further for extracting useful knowledge and producing personalized views of the e-learning system [32].

IX. Ontology and Semantic Web

Ontology provides an extendable and shareable framework to capture the common vocabulary in a domain of knowledge. It includes machine interpretable definitions of basic concepts in the domain and the relations that exist among them [33]. Presently, ontology is one of the popular knowledge representation techniques in the web.

Formally, ontology consists of entities, relationships, properties, instances, functions, constraints, rules, and other inference procedures. The power of ontologies rests with its ability to represent knowledge explicitly (as concepts, properties, and constraints); it's the ability to encode semantics (as meta-data, rules, and other inference procedures); and it's the ability to allow for a shared understanding of the represented formal knowledge within and in between humans and software.

In our paper, we employ ontological approach to represent the knowledge structure, interactions and Self-Regulated Learning (SRL) strategies for the following reasons.

- Share common understanding of the structure of the knowledge among people or program.
- Enable reuse of domain knowledge across different applications and experiments
- Analyze domain knowledge and interaction data independent of each other, as well as in conjunction with each other
- Provide formal representation through Ontology Web Languages (OWL), facilitating the use of constraints and reasoning based on Description Logic (DL) representing and reasoning with SRL tactics and strategies, encoding and sharing learner and content knowledge, and developing and using the cognitive model of the learner require ontological representation and reasoning at different levels of granularity.

Assuming that ontologies promote the use and the extension of a common formal conceptualization in each domain one may assume that simply employing ontologies in web-based systems would realize the goals of semantic web. Unfortunately, the world of semantic web is much more complicated than to be solved by such a simplistic notion. As we mentioned earlier the centrality of ontology is in the process of capturing conceptualiz-ations in the ontology. In a community of users interacting in a semantic web application that revolves around a common ontology,it is inevitable that inconsistencies arise in the ontology among multiple users over a period of time. Maintaining such inconsistencies in the ontology is quite intractable and remains the foremost challenge in semantic web. In this paper we identify a possible solution to overcome this challenge in terms of the evolu-tion of cognitive models of users that revise the ontology from time to time.

Recent surge in semantic web research has resulted in the evolution of W3C standard-Ontology Web Language (OWL). OWL enables the definition of domain ontologies, sharing of domain vocabularies, and the representation of the same at different levels of granularity. From a formal perspective, axioms and constructors in OWL capture the DL reasoning in terms of class consistency and consumption, in addition to other ontological reasoning.

There are different types of ontologies:

- Domain Ontologies capture the knowledge related to a particular type of domain.
- Upper Ontologies are related to several domains and not referred to the particular one.
- Application Ontologies are the type of ontologies which contain all the necessary knowledge to model particular application in or across domain.

- Structural Ontologies refer to any particular domain. They provide representational entities without stating what should be represented. In this paper we will present application ontologies and domain ontologies to show how we capture SRL knowledge in the ontologies and how we disseminate SRL specific inferred knowledge.

X. Ontology and e-learning

Ontology is a specification of a conceptualization [26]. Ontology consists of concepts, properties, constraints on their usage and relationships between the concepts. Ontologies have a wide application scope. And domain ontology, detailed description about an application specific domain is definitions of concepts, entities, attributes and processes related to a given application domain [33]. In this paper, our domain is e-learning system (MOODLE).

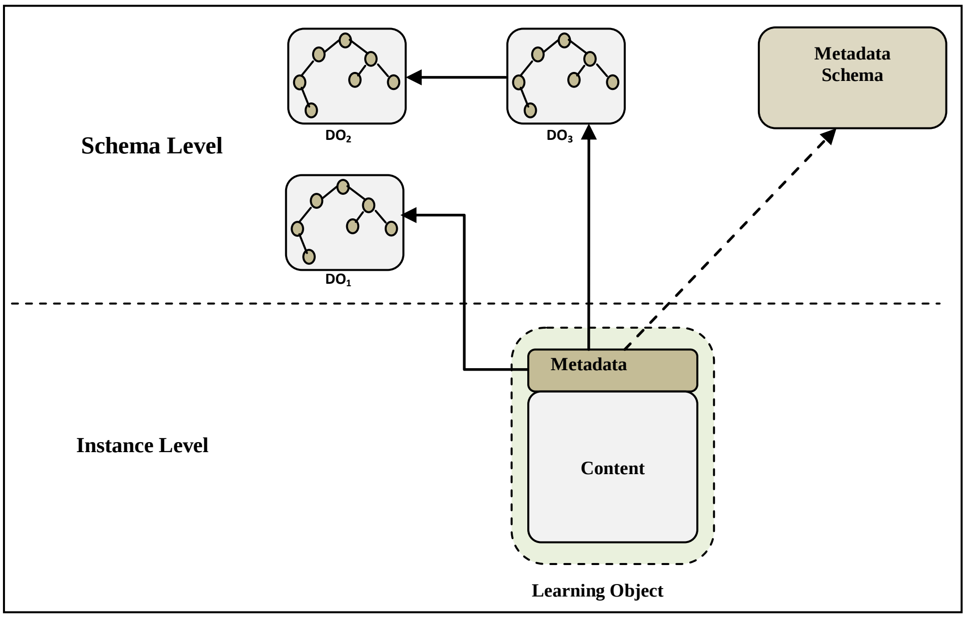

Figure 4: Different ontological levels of learning object metadata and domain ontologies (DOi)

XI. SCORM and Learning Content Metadata

The three main metadata standards defined are, IEEE Learning Object Metadata (LOM), Dublin Core metadata and SCORM metadata [34]. Out of them SCORM has the widest scope [35] and it consists of 49 student metadata elements.

This paper used only a subset of SCORM metadata, which can be extended. These belong to the learning state of domain objects. We expect to extend the usage and number of metadata in the course of future implementation and learner identification. The metadata what have been utilized in the ontology are, title, identifier entry, content type, content status, intended end user role, aggregation level. (Constraints were defined on them).

XII. Extensible Markup Languages (XML)

For all the new features and technical demands of future e-learning, XML seems to be a reasonable answer; XML is an important step in the direction of promoting the interoperability and flexibility of internet applications. XML was created as a way to structure, store and send information on the internet, unlike HTML, XML allows someone to create his/her own tags and define the DTD (Document Type Definition) or XML Schema, The DTD or schema supports a tree structure, which is much richer than a simple flat list and also respectful of cognitive and data processing requirements for economy and simplicity.[36]

Using XML as a language of metadata allows the user to create new kinds of descriptors that feature the learning objects. Since the schema ensures that the metadata is machine-readable and meaningful for the search engines, any Learning Management System (LMS), which chooses to support this schema, can use this metadata to select learning objects. Furthermore, through the use of XML Schema, learning objects can be structured and presented as nodes of trees in a content packaging file to reflect different levels of learning granularity and sequencing, which makes the combination of learning objects possible.

The XML Schema specification was developed to replace and amplify DTDs. Schemas express shared vocabularies and allow machines to carry out rules made by people. They provide a means for defining the structure, content and semantics of XML documents. XML Schemas have the same purpose as DTDs, but provide several significant improvements [37]:

- XML Schema definitions are themselves XML documents;
- XML Schemas provide a rich set of data types that can be used to define the values of elementary tags;
- XML Schemas provide a richer means for defining nested tags (i.e., tags with subtags);
- XML Schemas provide the namespace mechanism to combine XML documents with heterogeneous vocabulary.

There are languages transforms and translates XML data from one XML format into another, once Extensible Stylesheet Language (XSL), is the preferred style sheet language for XML, and XSL is far more sophisticated than the Cascading Style Sheet (CSS) used by HTML. XSL actually consists of three languages [38]:

- XSLT is a language for transforming XML documents into other types of documents, or into other XML documents.
- XPath is a language for addressing parts of an XML document. And it was designed to be used by XSLT.
- XSL Formatting Objects is an XML vocabulary for specifying formatting semantics.

From the above review of XML and the technologies associated with it, it is clear that XML can benefit an e-learning system with several advances: Firstly, XML Schemas provide a way to define a set of elements, which can establish a shared ontology among different organizations. This helps learning materials go through platforms and be reused without the problem of compatibility.

Secondly, the separation of content and presentation will enhance the flexibility of displaying learning materials. By adopting the standard XSLT files, learning materials may be transformed into a variety of possible standard forms.

Lastly, information stored in XML files is easy to search and retrieve due to the structure and constraint that XML files followed.

It seems that XML is almost ready to be used in such online systems as e-learning. However, it should be noted that change and development is occurring rapidly, and that XML is far from stable. Some guides about using XML in e-learning system have been published; however, no practice and experimental data are available yet. Therefore, using XML in a realistic environment is just in a tentative phase now.

XIII. Resources Description Framework (RDF)

In the late 1990s, the World Wide Web Consortium (W3C) Metadata Activity started work on RDF Schema (RDFS), a language for RDF vocabulary sharing. The RDF became a W3C Recommendation in Feb1999, and RDFS a Candidate Recommendation in March 2000, In February 2001, the Semantic Web Activity replaced the Metadata Activity, In 2004 (as part of a wider revision of RDF) RDFS became a W3C Recommendation, Though RDFS provides some support for ontology specification, the need for a more expressive ontology language had become clear.[39]

RDF has an XML syntax and many who are familiar with XML will think of RDF in terms of that syntax. This is mistake. RDF should be understood in terms of its data model. RDF data can be represented in XML, but understanding the syntax is secondary to understanding the data model.

The Resource Description Framework (RDF) is a standard (technically a W3C Recommendation) for describing resources. What is a resource? That is rather a deep question and the precise definition is still the subject of debate. For our purposes we can think of it as anything we can identify. You are a resource, as is your home page.

The interfaces representing resources, properties and literals are called Resource, Property and Literal respectively. In Jena, a graph is called a model and is represented by the Model interface.

Each arc in an RDF Model is called a *statement*. Each statement asserts a fact about a resource. A statement has three parts:

- the *subject* is the resource from which the arc leaves
- the *predicate* is the property that labels the arc
- the *object* is the resource or literal pointed to by the arc

A statement is sometimes called a triple, because of its three parts.

Writing RDF:

We can read and write RDF as XML with Jena methods. These can be used to save an RDF model to a file and later read it back in again.

```
<rdf:RDF
```

```
  xmlns:rdf='http://www.w3.org/1999/02/22-rdf-syntax-ns#'
  xmlns:vcard='http://www.w3.org/2001/vcard-rdf/3.0#'>
  <rdf:Description rdf:about='http://somewhere/JohnSmith'>
    <vcard:FN>John Smith</vcard:FN>
    <vcard:N rdf:nodeID="A0"/>
  </rdf:Description>
  <rdf:Description rdf:nodeID="A0">
    <vcard:Given>John</vcard:Given>
    <vcard:Family>Smith</vcard:Family>
  </rdf:Description>
</rdf:RDF>
```

The RDF specifications specify how to represent RDF as XML. The RDF XML syntax is quite complex.

RDF is usually embedded in an <rdf:RDF> element. The element is optional if there are other ways of know that some XML is RDF, but it is usually present. The RDF element defines the two namespaces used in the document. There is then an <rdf:Description> element which describes the resource whose URI is "http://somewhere/JohnSmith". If the rdf:about attribute was missing, this element would represent a blank node.

The <vcard:FN> element describes a property of the resource. The property name is the "FN" in the vcard namespace. RDF converts this to a URI reference by concatenating the URI reference for the namespace prefix and "FN", the local name part of the name. This gives a URI reference of "http://www.w3.org/2001/vcard-rdf/3.0#FN". The value of the property is the literal "John Smith".

The <vcard:N> element is a resource. In this case the resource is represented by a relative URI reference. RDF converts this to an absolute URI reference by concatenating it with the base URI of the current document.

XIV. Web Ontology Language (OWL)

Is a family of knowledge representation languages or ontology languages for authoring ontologies or knowledge bases. The languages are characterized by formal semantics and RDF/XML-based serializations for the Semantic Web. OWL is endorsed by the World Wide Web Consortium (W3C) and has attracted academic, medical and commercial interest.

In October 2007, a new W3C working group was started to extend OWL with several new features as proposed in the OWL 1.1 member submission. W3C announced the new version of OWL on 27 October 2009. This new version, called OWL 2, soon found its way into semantic editors such as Protégé and semantic reasoners [40].

The OWL family contains many species, serializations, syntaxes and specifications with similar names. OWL and OWL2 are used to refer to the 2004 and 2009 specifications, respectively.

The data described by an ontology in the OWL family is interpreted as a set of "individuals" and a set of "property assertions" which relate these individuals to each other. An ontology consists of a set of axioms which place constraints on sets of individuals (called "classes") and the types of relationships permitted between them.

c. OWL:

OWL was designed to preserve some compatibility with RDF Schema. For example, in OWL Full a class can be treated simultaneously as a collection of individuals and as an individual in its own right; this is not permitted in OWL DL. OWL Full allows an ontology to augment the meaning of the pre-defined (RDF or OWL) vocabulary. OWL Full is undecidable, so no reasoning software is able to perform complete reasoning for it.

d. OWL2 profiles:

In OWL 2, there are three sublanguages of the language. OWL 2 EL is a fragment that has polynomial time reasoning complexity; OWL 2 QL is designed to enable easier access and query to data stored in databases; OWL 2 RL is a rule subset of OWL 2.

Syntax: The OWL family of languages supports a variety of syntaxes. It is useful to distinguish high level syntaxes aimed at specification from exchange syntaxes more suitable for general use.

These are close to the ontology structure of languages in the OWL family.

This high level syntax is used to specify the OWL ontology structure and semantics.[41]

The OWL abstract syntax presents an ontology as a sequence of annotations, axioms and facts. Annotations carry machine and human oriented meta-data. Information about the classes, properties and individuals that compose the ontology is contained in axioms and facts only. Each class, property and individual is either anonymous or identified by an URI reference. Facts state data either about an individual or about a pair of individual identifiers (that the objects identified are distinct or the same). Axioms specify the characteristics of classes and properties. This style is similar to frame languages, and quite dissimilar to well known syntaxes for description logics (DLs) and Resource Description Framework (RDF).

RDF Syntaxes: Syntactic mappings into RDF are specified [41] for languages in the OWL family. Several RDF serialization formats have been devised. Each leads to a syntax for languages in the OWL family through this mapping. RDF/XML is normative.[41]

OWL2 XML Syntax:

OWL2 specifies an XML serialization that closely models the structure of an OWL2 ontology.

Examples: The W3C OWL 2 Web Ontology Language provides syntax examples.[42]

Tea ontology:

Consider an ontology for tea based on a Tea class. But first, an ontology is needed. Every OWL ontology must be identified by an URI (http://www.example.org/tea.owl, say). This is enough to get a flavour of the syntax. To save space below, preambles and prefix definitions have been skipped.

OWL2 Functional Syntax:

```
Ontology(<http://example.com/tea.owl>
   Declaration( Class( :Tea )))
```

OWL2 XML Syntax:

```
 <Ontology ontologyIRI="http://example.com/tea.owl" ...>
   <Prefix name="owl" IRI="http://www.w3.org/2002/07/owl#"/>
   <Declaration>
     <Class IRI="Tea"/>
   </Declaration>
 </Ontology>
```

RDF/XML syntax:

```
<rdf:RDF ...>
    <owl:Ontology rdf:about=""/>
    <owl:Class rdf:about="#Tea"/>
</rdf:RDF>
```

RDF/Turtle:

```
 <http://example.com/tea.owl> rdf:type owl:Ontology .
 :Tea  rdf:type            owl:Class .
```

Semantics:

Relation to description logic:

In the beginning, IS-A was quite simple. Today, however, there are almost as many meanings for this inheritance link as there are knowledge-representation systems.

Early attempts to build large ontologies were plagued by a lack of clear definitions. Members of the OWL family have model theoretic formal semantics, and so have strong logical foundations.

Description logics (DLs) are a family of logics that are decidable fragments of first-order logic with attractive and well-understood computational properties. OWL DL and OWL Lite semantics are based on DLs, They combine a syntax for describing and exchanging ontologies, and formal semantics that gives them meaning. For example, OWL DL corresponds to the SHOIN (D) description logic, while OWL2 corresponds to the SROIQ (D)logic.[43] Sound, complete, terminating reasoners(i.e. systems which are guaranteed to derive every consequence of the knowledge in an ontology) exist for these DLs.

Relation to RDFS:

OWL Full is intended to be compatible with RDF Schema (RDFS), and to be capable of augmenting the meanings of existing Resource Description Framework (RDF) vocabulary, A model theory describes the formal semantics for RDF, This interpretation provides the meaning of RDF and RDFS vocabulary. So, the meaning of OWL Full ontologies are defined by extension of the RDFS meaning, and OWL Full is a semantic extension of RDF.[44]

Example: For example, Employee could be the subclass of class owl:Thing while Dealer, Manager, and Labourer all subclass of Employee.

Properties: A property is a directed binary relation that specifies class characteristics. It corresponds to a description logic role. They are attributes of instances and sometimes act as data values or link to other instances. Properties may possess logical capabilities such as being transitive, symmetric, inverse and functional. Properties may also have domains and ranges.

Data type properties: Data type properties are relations between instances of classes and RDF literals or XML schema datatypes.For example, modelName (String datatype) is the property of Manufacturer class. They are formulated using *owl:DatatypeProperty* type.

Object properties: Object properties are relations between instances of two classes. For example, ownedBy may be an object type property of the Vehicle class and may have a range which is the class Person. They are formulated using *owl:ObjectProperty*.

Operators: Languages in the OWL family support various operations on classes such as union, intersection and complement. They also allow class enumeration, cardinality, and disjointness.

XV. Discussion and Related work

16.1 Applying ontologies to support the evaluation of open questions-based tests:

In this paper, a system to evaluate students' exams by using semantic web technologies has been presented. The main problems concerning evaluation of open questions in e-learning were presented in this work. Our solution is an attempt to simplify and improve evaluation processes in e-learning. Our approach is based on the use of semantic web technologies. A similar approach can be found in [45]. There, a learning and assessment system based on the writing of course hyperbooks and the comparison of domain ontologies is presented. Each group of students makes its own hyperbook from a course ontology and the different hyperbooks and compared and discussed. However, our purpose is different, because our approach tries to mark the exams completed by the students. In particular, our solution proposes the use of ontologies for representing and managing knowledge in e-learning, extracting knowledge from texts, annotating both the evaluation tests and the intervention of students. Then, the knowledge acquisition process results are evaluated through the comparison of the ontology extracted from the student and the defined for the particular course. The long-term objective of this evaluation methodology is to reduce the time the teachers have to spend in open questions-based continuous evaluation processes; in this way, teachers can spend more time paying attention to the students instead of to the marking process, so improving the effectiveness of the collaborative learning environment. However, this is not yet accompli-shed because at the present time, the knowledge has to be manually annotated by the teachers for both exam questions and responses, although we expect to include some NLP component to help to make the process (semi)automatic. This system is going to be used for the next academic year in some courses at the University of Murcia, because this methodology can be applied to any type of course independently from the teaching paradigm. A future objective is the integration of the evaluation approach into educative platforms such as MOODLE or SUMA (which is the learning tool of the University of Murcia).

Comment: In this paper, displayed system exams to assess students using semantic web technologies. And presented in this work, the main problems related to the assessment of open questions in e-learning systems. It was proposed to use ontology representation and knowledge management in e-learning, and extract knowledge from text, to solve all the problems of assessment tests for students. Then, is the process of evaluating the acquisition of knowledge and the results obtained through the comparison between the ontology data extracted from the student identify a specific path. And thus improve the effectiveness of the collaborative learning environment. And the future goal is to integrate the evaluation approach to learning platforms such as MOODLE. The study also focused on how to extract data on how students answer questions in the exams ontologies and linked data did not address how to link them together and put them in the right place have to be more relationship among them using the concept of ontologies.

16.2 Searching context relevant learning resource using ontology mappings:

In this paper we introduced a framework for bridging gaps among different e-learning ontologies using ontology mappings. Having implemented the search algorithm on top of that framework, we developed a learning system that allows learners to search for learning resources in a remote digital library (the ACM DL and Merlot) using a course curriculum (Information Management), to generate the queries compliant with a target digital library ontology, and hence to get more relevant learning resources for the local course context learners are familiar with. In addition, students can use the web courses with the same front end (i.e. user interface) and without need to have any additional knowledge about technical aspects such as SKOS, RDF, ontologies, etc.

Although it is not explicitly shown in the paper, the proposed solution scales up to support multiple ontologies, providing we have mappings among the source ontology and any potential target ontologies. In a case we apply the approach to another uses case, such as a federated search engine, we should further improve it. For example, a federated search setting presumes that we could have several source ontologies. That is to say, each ontology in the federation can be acted as the source ontology. A similar problem was recognized in the ELENA project [46], but in terms of different metadata schemas involved in the federation. The applied solution was to define one common schema and mappings among that schema and each specific schema in the federation. However, we are dealing with domain ontologies (not metadata schemas) where we can use several domain specific ontologies (computer science, psychology, etc) the same federation. Finding one core domain ontology in this case is more difficult. One of possible solution is to use Dewey Decimal Classification (DDC) or Library of Congress Classification (LCC) as proven solution in the present library practice. Still there are some issues that have to be solved in the future in order to have all enabling tool of the proposed framework. First, the shown application example do not have a directed control over the ranking of search results due the use of digital libraries that only return results in a presentational form (i.e. HTML). Screen scraping techniques have already been proposed as a solution to similar problems on the Semantic Web [47]. Similarly, the Personal Publication Reader uses Lixto Web Wrapper to extract and syndicate heterogeneous data sources [48]. By transforming search results into an RDF-based format we will not only be able to rank search results, but also to combine results from different sources (Merlot, ACM DL), and hence create one common result set. Second, teachers need a simple tool for generating the course ontology from the outline as well as facilitating mapping creation. Currently, it is possible to use well known OWL ontology editors such as Protégé for developing both SKOS-based domain ontology and ontology mappings. With the tool we are currently developing, teachers will not have to know anything about RDF, ontologies and other technological aspects. The eventual goal is to have a tool that will automatically generate mapping relations among ontologies. In the future we will also integrate the implemented search algorithm as a component in learning applications for querying different sources of learning resources (e.g. federated search), and thus improving the interoperability of learning systems in general. We also plan to analyze the benefits of the use of semantic web student modeling techniques to better filter out the found learning resources as well as to deliver more personalized search results.

Comment: This paper was presented a framework to bridge the gaps between different ontologies using e-learning ontology mappings. Then put learning system that allows learners to search for learning resources in the digital library remotely like (Merlot, ACM DL) In addition, students can use the online courses on user interface without the need for any additional knowledge about the technical aspects such as SKOS, RDF , Ontologies, etc. It although does not appear clearly in this paper, and the proposed solution focuses on supporting multiple ontologies, which provide us with appointments (shifts) between sources and potential target ontology. In this case, we apply another approach uses this situation, such as a unified search engine, and we should continue to improve it. For example, is supposed to prepare a unified research can have several sources of ontologies. This means, can links each ontology with source ontology. There are still some issues to be solved in the future in order to have a tool that enables each of the proposed frameworks. First, an example of the application of control does not appear on the order directed the search results due to the use of digital libraries which returns results only in the form of presentation (HTML) has already been to propose other techniques as a solution of these problems, such as the Semantic Web technologies. It is possible to use the technique (OWL). A technique that we are going to be applied and developed currently, the learners do not know anything about (RDF), ontologies and other technological aspects. The ultimate goal is to have this tool would generate relationships between mapping ontologies automatically. And we will also incorporate search algorithm and its implementation as a component in learning applications to query for the different sources of learning resources (such as unified search), so improving the interoperability of learning systems in general. We also plan to analyze the benefits of using Semantic Web technologies to filter out the best of the data from the learning resources as well as to provide more accurate search results.

16.3 An adaptive e-learning model for the Semantic Web:

There is an agreement that the adaptation of the content to the learner's characteristics is the key to obtain efficiency, and that the cost of development of adaptive systems is the great obstacle that prevents more elaborated tools from being created.

The fusion of web-based education with adaptive systems, metadata and ontologies is surely a non-trivial process that involves the creation and the implementation of standards that can be used by different educational system designers. Besides the definition of such standards, there is the necessity of changes on the adaptive techniques used so far, due to the fact that they are based on the domain of the knowledge supposed to be presented.

Finally, it is important to point out that the presented project is in its development process, and the domain and the pedagogical ontologies are already being created, as well as the tools able to produce the course package, with the structure and the resources according to the SCORM Content Aggregation Model. The construction of the ontology of adaptation and the auxiliary modules that allow the definition of the adaptive behavior of the course still remain to be done, and it will be incorporated on the package that already exists.[49]

Comment: This paper is focused on how to adapt to learners with educational content, as well as the fusion of education on the internet with e-learning systems, it is certainly a process of great importance and involves the establishment and implementation of standards that can be used by different designers of the educational system. In addition to the definition of these criteria, so there is a need for changes to the adaptive techniques used so far, due to the fact it's based on the field of knowledge that have been submitted. And therefore we will focus in this paper on building tools capable of producing a package educational related resources and structure according to the standard (SCORM) and building ontology for this package to adapt to the ancillary units that allow the definition of adaptive behavior to be done, and will be incorporated into the packages that already exist in the educational system.

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