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Semantic Web to E-Learning Content

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Abstract— ***E-Learning is the use of technology to enable people to learn anytime and anywhere. Semantic Web incorporates efforts to build an efficient web that enhances content with formal semantics, which enables better possibilities for navigation and accessing its contents. Semantic Web cooperation is only possible through conceptual arrangements of web contents. Ontology technology is considered to be a highly suitable means of establishing such conceptual arrangements in educational-technology systems. It has an important role in instructional design and the development of courses in E-Learning. This paper mainly discusses the semantics applied to learning content to enable large scale collaboration of E-Learning activities over service-oriented infrastructures. Also, the significance of semantic web in E-Learning content and the use of ontology in developing E-Learning content are discussed. In addition, the tools, languages, steps and approaches for ontology development are also discussed. By focusing on ontology in content infrastructure realize E-Learning community as efficient learning in more productive and innovative learning organizations.***

Keywords—E-Learning; Semantic Web; Ontology; E-Learning Content; Ontology Languages

I. INTRODUCTION

With the development of the information technology and the wide use of the internet in the recent years, web has become an important learning platform. Its accessibility has made it a successful environment particularly for E-Learning education and gives rise to various methods in content delivering. E-Learning allows you to be educated on any subject, at any time and in many different locations. The existing resource representation available for E-Learning education in web does not have a unified standard and usually lack semantic information. Moreover, there is no powerful mechanism for organizing the learning material, as a result speed of searching of suitable resource become too time consuming. Semantic web appears to be a promising technology for implementing E-Learning. It is an intuitive web application with the ability to access information which is needed precisely. The future of semantic web depends largely on the spread of ontology. Ontology in semantic web, associate the information in organized units that people and computers can understand and allow sharing and reusing of information. Therefore, well-structured ontology prevents information about different areas from existing together in an unorganized manner. Semantic web, ontologies provide a new perspective on intelligent educational systems by providing intelligent access to and management of web information and semantically richer modelling of the applications and their users. This allows for supporting more adequate and accurate representations of learners, their learning goals, learning material and contexts of its use, as well as more efficient access and navigation through learning resources.

The rest of the paper is organized as follows. Section II discusses E-Learning and its potential, its requirements, its platform and tools. Section III presents general description about semantic web its framework and its components. Section IV discusses the impact of semantic web in E-Learning content, Section V describes the significance of using ontology in E-Learning content and discusses tools, languages, steps and approaches used for ontology development and the final section presents the conclusion.

II. E-LEARNING

E-Learning is an effective learning process created by combining digitally delivered content with (learning) support and services [1]. It includes a wide set of applications and processes, including web-based learning, computer-based learning, virtual classrooms, and digital collaboration.

A. E-Learning and its Potential

E-Learning allows for online interaction between learners and their instructors without any face-to-face meetings. This type of learning is self-paced, self-directed and cost effective as it reaches many students with reduced travelling expenses. It is usually moderately interactive, synchronous i.e., real-time, multiple students online, instructor-led and asynchronous i.e., where students and instructor have an intermittent interaction through online bulletin boards, online discussion groups and e-mail, Or, it may be totally self-contained with links to reference materials in place of a live instructor. It provides cost-savings, time-savings, convenience, more personal contact, and more retention and stronger grasp on the subject matter.

B. E-Learning Requirements

E-Learning system has its origin in computer-based training (CBT), which attempt to replicate autocratic teaching styles and develop self-paced learning. Standard or traditional learning processes [2] can be characterized by

centralization of authority (content is selected by the educator), strong push delivery (instructors push knowledge to students), lack of a personalization (content must satisfy the needs of learner) and the linear/static learning process (unchanged content). These type of learning processes results in an expensive, slow and too unfocused (problem-independent) learning process.

But the focus of E-Learning is to extend and improve the users and business' needs and to remove the barriers of time and distance. Key to success is the ability to reduce the cycle time for learning and to adapt "content, size and style" of learning to the respective user and their business environment. This can be solved with E-Learning, i.e. with a distributed, student-oriented, personalized, and non-linear/dynamic learning process.

A summary view of E-Learning requirements are presented below [2]: **Delivery:** Allow student to determine the agenda, **Responsiveness:** Allow student to responds to problem at hand, **Access:** Allows direct access to knowledge in any progression, **Symmetry:** Allows learning as an integrated activity, **Modality:** Allow learning to run in the parallel to business tasks, **Authority:** Allow content come from the interaction of the participants and the educators, **Personalization:** Allow content to be determined by the individual user's needs and aims to satisfy the needs of every user, **Adaptivity:** Allow content to be changed constantly through user input, experiences, new practices, business rules and heuristics. The difference between training and E-Learning is described in the below table:

TABLE I

DIFFERENCES BETWEEN TRAINING AND E-LEARNING [3]

Dimensions	**Training**	**e-Learning**
Delivery	Push – Instructor determines agenda	Pull – Student determines agenda
Responsiveness	Anticipatory – Assumes to know the problem	Reactionary– Responds to problem at hand
Access	Linear – Has defined progression of knowledge	Non-linear – Allows direct access to knowledge in whatever sequence makes sense to the situation at hand
Symmetry	Asymmetric – Training occurs as a separate activity	Symmetric – Learning occurs as an integrated activity
Modality	Discrete – Training takes place in dedicated chunks with defined starts and stops	Continuous – Learning runs in the parallel to business tasks and never stops
Authority	Centralized – Content is selected from a library of materials developed by the educator	Distributed – Content comes from the interaction of the participants and the educators
Personalization	Mass produced – Content must satisfy the needs of many	Personalized – Content is determined by the individual user's needs and aims to satisfy the needs of every user
Adaptivity	Static – Content and organization/taxonomy remains in their originally authored form without regard to environmental changes	Dynamic – Content changes constantly through user input, experiences, new practices, business rules and heuristics

C. E-Learning platforms and Tools

There are numerous E-Learning platforms available on the market, each offering a number of tools and functions for the learner, trainer and the administrator. There are many attempts at building learning platforms and tools [2]:

Brokerages for educational systems: These systems have their own educational metadata schemes. A brokerage aims at provide searching services for learners, resource acquisition, distribution and billing, in addition to easy access to content providers.

Commercial Web-based course tools: Include E-Learning portals such as WebCT and BlackBoard.

The Open Knowledge Initiative (OKI): This project is initiated by the Massachusetts Institute of Technology (MIT) in order to provide all of their courses online.

Conzilla: It is a first prototype of a concept browser that has two modes of exploration such as browsing and querying.

Edutella: Peer-to-peer architectures enable institutions to participate in a sharing network without losing control over their resources. The Edutella project suggests an RDF-based notation to describe sharable learning resources in a peer-to-peer architecture. It includes set of services like searching, mapping and replication.

Virtual Workspace Environment (VWE): It is a distributed learning management system which includes a small configurable operating system that can run in a web browser, which allows users to access their own learning environment from everywhere.

Personalized Access to Distributed Learning Repositories (PADLR): This project is the distributed Learning web infrastructure, which makes it possible to exchange/author/annotate/organize/market and personalize/navigate/use/reuse modular learning objects, supporting a variety of courses, disciplines and universities".

The courseware watchdog project: This project is produced by the Basic Support for Cooperative Work (BSCW), which is a tool for computer supported collaboration projects that can be managed online and access to important documents from anywhere, at anytime. It is more suitable for e- business than E-Learning.

Pegasus LMS [4]: It is a "learning management system", a latest generation web-based learning system capable of performing a whole range of functions via Intranet or Internet. The system consists of a "suite" of integrated applications that use a modular structure to cover various types of functions.

III. SEMANTIC WEB

Semantic Web is a "web of data" that are defined and linked in a way that enables machines to understand the semantics, or meaning, of information on the World Wide Web. It is an intuitive web application with the ability to access information which is needed precisely. It offers learners the possibility of having a wealth of related content delivered to their desktop without explicitly identifying or requesting it. E-Learning facilitators can utilize this rich content to enhance the learning experience, allowing them to deliver engaging and relevant courses [5].

A. Semantic Web Framework [5]

Semantic technologies provides common framework and define the communication between systems in addition to the standards that govern the data and structure of semantic web. The Representational State Transfer (REST) software architecture is a style of software architecture already defined for the distributed systems such as World Wide Web. Within this structure, the Simple Object Access Protocol (SOAP) is a packaging protocol used for calling specific functions remotely and for the applications that send messages back and forth to execute some functionality described by a Web service while the Universal Discovery Description Integration (UDDI) standard provides access to the web services and provide access to Web Services Description Language (WSDL) describing the message formats and protocol bindings required to interact with the web services. Fundamentally, these standards and architecture exist to facilitate the smooth and efficient exchange of data across different computers and networks as shown in Fig.1.

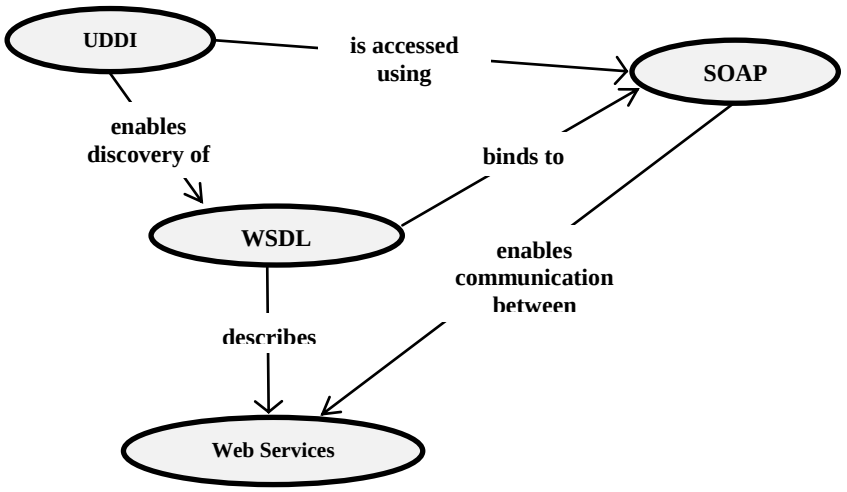

Fig. 1 Layered Approach to Semantic Web [6]

A third major element, Intelligent Physical Agents (IPAs), is software that is distributed in parallel and exhibits some aspects of artificial intelligence such as reasoning and learning. In semantic web, IPAs create connections between the contents, mapping relationships, providing user recommendation, efficient searching of contents and anything that is capable of goal directed behavior.

B. Semantic Web Components

In essence, the Semantic Web is a collection of standards, data structures, and software that make the online experience more detailed, intelligent, and in some cases, more intense [5]. First, language of HTML was developed in a way that people would understand the information rather than giving meaning to the information presented. Next, the languages of XML, RDF and OWL were developed to meet the need of giving meaning to the information and to add structural information for describing all ideas and concepts in the web environment and then relating these to each particular subject area.

The Semantic Web standards established by the W3C (World Wide Web Consortium) and approved throughout the world include the tools of XML, XML Schema, RDF, RDF Schema, OWL and URIs. Semantic portals technology is built in a layered manner, i.e. it is processed in steps, each step built on top of another [7] is shown in Fig.2.

Each of these technologies are described below:

1) XML (EXtensible Markup Language): XML, which is an "extensible markup language", defines a set of rules for encoding documents in a format that is both human-readable and machine-readable [8]. It is developed by the W3C institution established in the leadership of Tim Berners-Lee. In essence, XML lacks a semantic model [9]: it has only a "surface model", a tree. So, XML is not the solution for propagating semantics through the semantic web. It only plays the role of a "transport mechanism", viz. as an easily machine-processable data format.

2) XML Schema: An An XML schema is a description of a type of XML document, typically expressed in terms of constraints on the structure and content of documents of that type, above and beyond the basic syntactical constraints imposed by XML itself [10]. XML Schemas are primarily used to validate the structure and data types of an XML document.

3) RDF (Resource Description Framework) [11]: RDF is a family of World Wide Web Consortium (W3C) specifications originally designed as a metadata data model. At the same time, RDF constitutes the fundamental standard

of Semantic Web. It is a language for describing information and resources on the web. It provides foundation for processing meta-data and describing the content available on the Web. These standards can prevent user from accessing irrelevant subjects. It is based upon the idea of making statements about resources (in particular Web resources) in the form of subject-predicate-object expressions. These expressions are known as triples in RDF terminology. The subject denotes the resource, and the predicate denotes traits or aspects of the resource and expresses a relationship between the subject and the object.

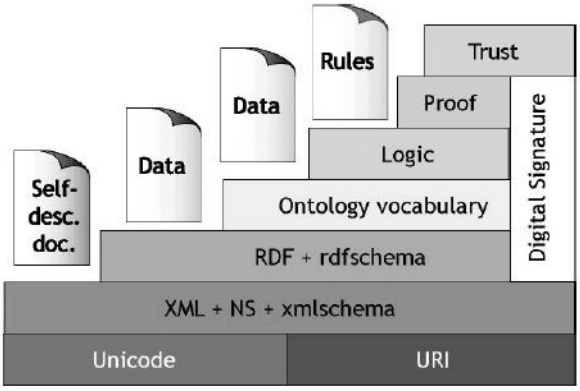

Fig. 2 Layered Approach to Semantic Web [7]

In general [9], RDF(S) suffers from a lack of formal semantics for its modelling primitives, making interpretation of how to use them properly an error-prone process. A solution to this problem is provided by the third basic component of the Semantic Web, viz. ontologies.

4) RDF Schema: RDF schema [12] is a language for declaring basic class and types for describing the terms used in RDF. A recent proposal [9] extending RDF and RDF Schema is OIL (Ontology Interchange Language). OIL unifies the epistemologically rich modelling primitives of frames, the formal semantics and efficient reasoning support of description logics and mapping to the standard Web metadata language proposals. The DAML+OIL language has also been developed as an extension to XML and RDF. It heavily relies on OIL and is a similar representation language for describing web resources and supporting inference over those resources.

5) OWL (Web Ontology Language) [13]: It is a family of knowledge representation languages for authoring ontologies. 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.

OWL [14] is a language for processing web information. It was designed to provide a common way to process the content of web information (instead of displaying it). It was designed to be read by computer applications (instead of humans). OWL and RDF are much of the same thing, but OWL is a stronger language with greater machine interpretability than RDF. OWL comes with a larger vocabulary and stronger syntax than RDF.

6) Logic, Proof and Trust: Logic layer enables intelligent reasoning with meaningful data. Rule layer executes all the semantics and rules below proof and the result will be used to prove deductions. The proof along with trusted inputs means that the results can be trusted. To verify the origin of the sources, cryptography means such as digital signatures are to be used. Above all layers i.e., top layer application with user interface can be built.

IV. SEMANTIC WEB IN E-LEARNING CONTENT

"Making content machine-understandable" is a popular paraphrase of the fundamental prerequisite for the semantic web. The semantics to learning content is to enable large scale collaboration of E-Learning activities over service-oriented infrastructures. This is because of the complexity of learning resources and the ability to create machine readable semantic meta-data. In order to use semantics that are shared and reused across different applications it is necessary at the conceptual level to form a consensus in the domain. Ontology is key technologies used to actualize semantic web community. It is the building block for the semantic web. Ontologies applied to the web are creating the semantic web. It represents the particular meanings of terms as they apply to a domain. It is therefore important that any semantic for the web is based on an explicitly specified ontology. The rich semantics offer both teachers and learners new opportunities for locating and reusing resources.

A. Benefits of Semantic Web for E-Learning Content

Some of the advantages of semantic web in E-Learning content are given below [9]:

Delivery: Ontologies link the learning materials distributed on the web. This enables construction of a user-specific course by semantic querying for topic of interest.

Responsiveness (Responds to problem at hand): Software agents use commonly agreed service language in semantic web enables co-ordination between agents and proactively deliver learning materials in the context of actual problems.

Access: User can perform semantic querying for the suitable learning material based on his situation such as goal of learning, previous knowledge, etc.

Personalization: Ontology link user needs and characteristics of the learning material which enables customized searching for learning material based on his/her needs.

Adaptivity: The semantic web enabled by semantical annotation of content enables continuous improvement of learning materials.

Symmetry: The semantic web offers the potential to become an integration platform for all learning activities.

Modality: Active delivery of information based on personalized agents creates a dynamic learning environment.

Authority: Enables an effective co-operative content management as semantic web will be as decentralized as possible.

V. ONTOLOGIES IN E-LEARNING CONTENT

Ontologies are specifications of the conceptualization and corresponding vocabulary used to describe a domain. They are well-suited for describing heterogeneous, distributed and semi structured information sources that can be found on the Web. Ontology comprises a set of knowledge terms, including the vocabulary, the semantic interconnections, and some simple rules of inference and logic for some particular topic [15]. It is defined as a data model that represents a domain by a set of concepts and the relationship between these concepts. It is used to search and perform actions in the web in a standardized way. Instructors can utilize this in creating contents of the courses in E-Learning and learners can avail this in accessing content in a knowledge guided way.

The need of ontology in E-Learning is to facilitate knowledge sharing and reuse, i.e. a common understanding of various contents that reaches across people and applications, to set grounds for developing reusable web-contents, introduce standards to allow interoperability, to make domain assumptions explicit and to separate domain knowledge from the operational knowledge.

B. Three Ontology Levels Related to E-Learning Content

There are three ontology levels related to E-Learning content usage [7] are shown in the below Fig.3:

Content Ontology: Content ontology as it name implies it describes the content of the learning material. It describes the basic concepts of the domain in which learning takes place. It includes relation between concepts, and some basic properties.

Context (Pedagogy) Ontology: Context ontology describes the form in which the topic is presented. It captures the function of a learning resource. Examples of learning contexts are lecture, tutorial, example, figure, walk-through, exercise, solution and so on. It mainly helps in context-relevant searching for learning materials. **Structure Ontology:** Structure ontology defines the logical structure of the learning materials. It is used to connect the chunks of learning material to create the whole learning course. Relations like previous, next, hasPart, isPartOf, and isBasedOn are used to design the structure of E-Learning materials.

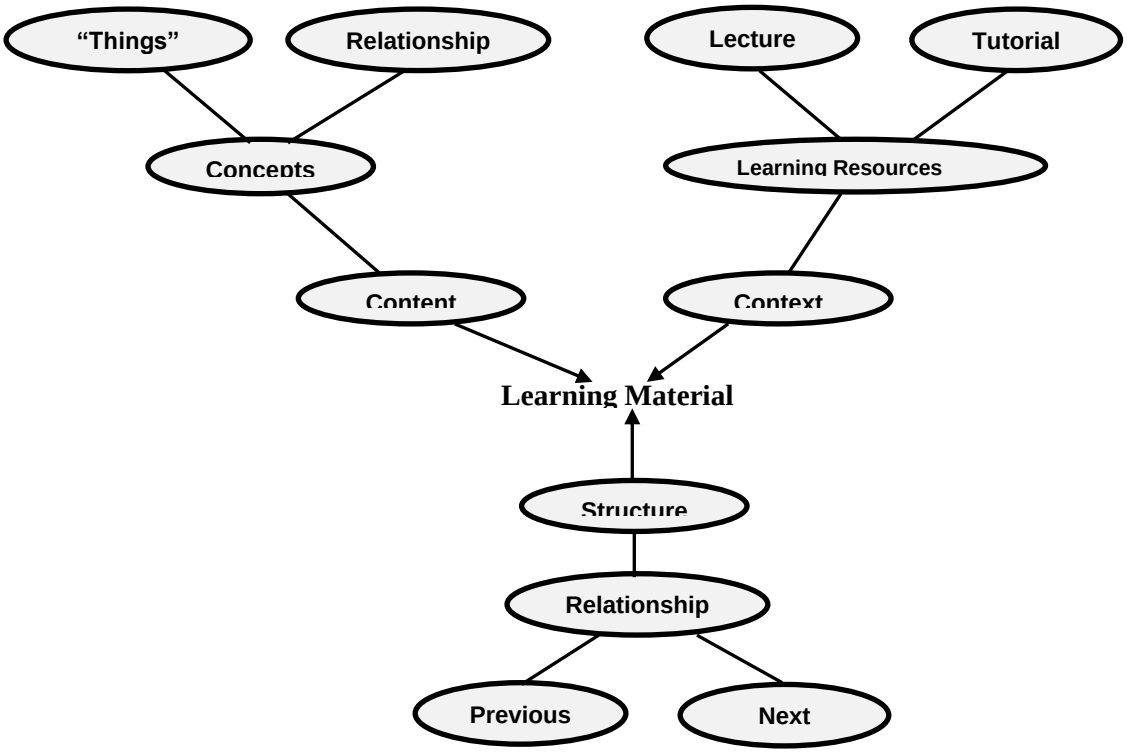

Fig. 3 Three Ontology Levels

C. Ontology Development Tools

In practice, ontologies are often developed using integrated, graphical, ontology-authoring tools, such as Protégé, OILed, OntoEdit, Ontolingua, Chimaera etc. Protégé is a graphical ontology-development tool which supports a rich knowledge model and is open-source and freely available, Applications developed with Protégé are used in problem-solving and decision-making in a particular domain.

Tools are used to develop new ontologies and modify existing ones. They let the author edit and develop ontologies concentrating on the domain's concepts and relationships, without worrying much about ontology-representation languages. The author can choose ontologies from a list, choose attributes and relations from another list, edit, add, remove, and merge ontologies. The output is usually produced in a specific high-level ontology-representation language such as OWL, RDF/RDFS, HTML, or in plain text [15].

D. Ontology Development Languages

There are a lot of such languages around for representing ontologies, and most of them are based on XML (eXtensible Markup Language), XML Schemas, RDF (Resource Definition Framework), and RDF Schemas, all four developed under the auspices of W3C and using XML syntax [15].

There are a number of such languages for ontologies, both proprietary and standards-based. For example [16]:

OWL: Ontology Web Language (OWL) is a family of knowledge representation languages for authoring ontologies, and is endorsed by the World Wide Web Consortium. It is used to explicitly represent the meaning of terms in vocabularies and the relationships between those terms. Its advantage over other languages (XML, RDF, and RDF Schema (RDF-S)) is that it facilitates greater machine interpretability of web content by providing additional vocabulary along with formal semantics.

KIF - Knowledge Interchange Format (KIF) is a computer-oriented language for the interchange of knowledge among disparate computer programs.

Cyc is an artificial intelligence project that attempts to assemble a comprehensive ontology and knowledgebase of everyday common sense knowledge, with the goal of enabling AI applications to perform human-like reasoning. It has its own ontology language called CycL.

RIF - Rule Interchange Format (RIF) effort involves the development of a format for interchange of rules in rule-based systems on the semantic web. The goal is to create an interchange format for different rule languages and inference engines.

OIL, OIL extends RDF Schema [17]: It is the ontology creation language which allows the user to be much more specific about what sort of thing a person is, the properties a thing needs to have to be and so on.

E. Ontology Development

Ontology development is normally done in the following three ways:

Manual: Generally, ontologies are developed manually. Manual ontology building requires lots of efforts by domain experts and hence time consuming and costly. To reduce the effort of manual ontology building, the feasibility of semi automatic and automatic ontology building have been explored. In order to overcome the manual development problems many methods have been developed, including systems and tools that automatically or semi-automatically, using text mining and machine learning techniques, allows to generate ontologies.

Semi automatic: In semi automatic ontology development, system aids the user during the ontology construction process. At the same time, human intervention is also needed during ontology process.

Fully automatic: In fully automatic, the system takes care of the complete development. Automatic creation of ontologies starts by extracting terms and concepts or noun phrase from plain text using a method from terminology extraction. Then statistical or symbolic techniques are used to extract relation signatures. The intentional aspects of domain are formalized by ontology.

F. Steps for Ontology Development [18]

Ontology development involves the following six basic steps: Ontology scope, Ontology capture, Ontology encoding, Ontology integration, Ontology evaluation, Ontology documentation which is shown in the below Fig.4:

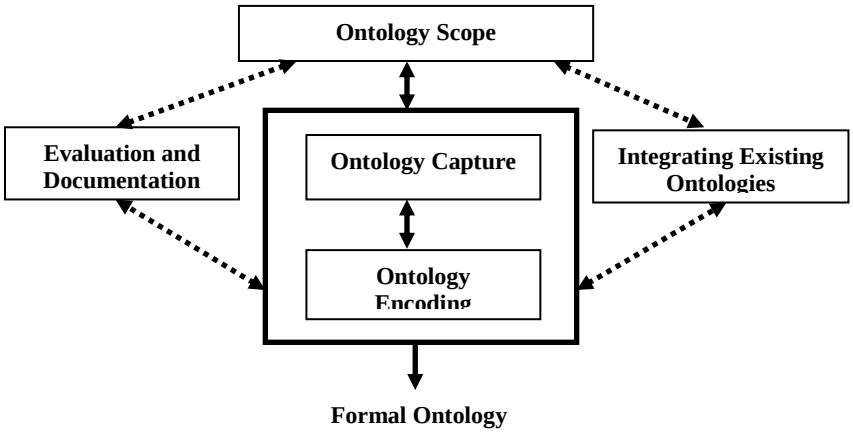

Fig. 4 Ontology Development Steps

Ontology Scope: It concerns to clearly identify the ontology purpose and its intended uses, that is, the competence of the ontology. To do that, competency questions such as: What is the domain that the ontology will cover? For what we are

going to use the ontology? Identify whether ontology has to be built from scratch or an existing ontology can be used? For what types of questions the information in the ontology should provide answers (competency questions)? are used. Answers to these questions may change during the lifecycle.

Ontology Capture: There are two steps for ontology capture: First one is concept identification (Important domain terms) which identifies key concepts and their relationships in the domain of interest. Concepts are modeled as classes or sub classes and relations are represented as is-a, part-of and so on. Second is concept organization (Class/concept hierarchy) which explains the different ways to represent ontology which are top down approach, bottom-up approach, combination approach and graphical notation (Entity-Relation(ER) diagram).

Ontology Encoding: It aims to explicitly represent the conceptualization captured in a formal language. Example for representation language that will support ontology are SOHT, OWL, RDF, XOL etc. OWL and RDF is defined over XML. It is done by constructing semantic pattern (express special meaning) with the help of pattern editor. Eg., Protégé 2000 with RDFS, Protégé IDE-Generate OWL or RDF as language.

Ontology Integration: It combines constructed ontology with the existing one. In most cases, new ontologies are constructed since new classes, relations, instances and axioms does not match with the related ontologies in the respective areas.

Ontology evaluation: Ontology must be evaluated to check whether it satisfies the specification requirements. Two types of evaluation criteria used are generic evaluation which deals with factors like clarity, consistency, reusability, specific evaluation which checks the generated ontology against purpose and user requirements. Eg., Internal evaluation done by team of ontology builders. External evaluation is done by client. Competency questions are asked to evaluate the correctness of the ontology. The two main factors considered for evaluation are precision and recall.

Ontology Documentation: Ontologies can be reused only if it is properly documented. All the ontology development must be documented, including purposes, requirements and motivating scenarios, textual descriptions of the conceptualization, the formal ontology and the adopted design criteria. It should be done with at most care and must record all the assumptions that are made explicitly.

G. Approaches for Ontology Development [19]

Ontology development is based on the type of input that the systems consider to initiate the process of ontology generation. The authors distinguished between ontology generation from text, dictionary, knowledge base, semi-structured schemata and relational schemata. Different ontology development approaches are distinguished on the type of input used for learning. They propose five classifications:

Ontology learning methods from text: This method uses more sophisticated statistical and NLP techniques for the ontology generation. The most well-known approaches from this group are pattern-based extraction, association rules, conceptual clustering, ontology pruning, concept learning etc.

Ontology learning methods from dictionary: This method uses machine readable dictionary as a source to extract relevant concepts and relations among them.

Ontology learning from a knowledge base: This method uses existing knowledge base of rules as source.

Ontology learning from semi-structured data: This method uses any predefined structure, such as XML schemas as source.

Ontology learning from relation schemas: This method uses knowledge in database as source to extract relevant concepts and relations.

VI. APPLICATIONS OF ONTOLOGY AND SEMANTIC WEB TECHNOLOGY TO E-LEARNING CONTENT [20]

A classification of different forms of application of ontology and semantic web technologies for E-Learning systems is discussed below:

Ontology development: Ontology development is the automated extraction of knowledge from existing resources such as textbooks in the form of ontologies. This needs techniques different from the classical ontology engineering approaches. Natural language processing techniques are also applied to automatically generate ontologies. The ontology editor such as Protégé, compatible with OWL become available enables the development on ontologies specific to the educational context.

Content Creation and Generation: Content authoring comprises the creation of educational content from scratch by an author or instructional designer and the generation of content from resources such as ontologies. The OntAWare authoring tool fully automates content development, which can produce reasonably complete outlines if rich ontologies are available as input. In contract to OntAWare, AIMS system is another more semi-automatic, interactive approach to ontology-based authoring of content. It support a generic set of authoring tasks within the system. It guides an author through standard interactive authoring dialogues. It suggests solutions along the way and supports the creation of courses, topics, concepts, and tasks, allowing the author more influence than an automated solution.

Metadata and Annotation: To allow the publication and discovery of sharable web resources by potential users, the abstract description of learning content through metadata is necessary. A prerequisite for this to work is a standardized and agreed upon vocabulary for these annotations. Annotation of fragments can help to link these to underlying knowledge, thus making the knowledge explicit. Ontology technology can provide in this context the knowledge support through taxonomy and thesaurus functionalities. Both metadata and annotation provide meta-level information, but at different levels of granularity.

Metadata is data about data that helps us to achieve better search results. With the help of metadata description resource can be annotated. The Learning Object Metadata standard LOM, although not ontology-based, provides a basic metadata

framework for the facetted description and classification of learning objects. Metadata relies on the provider to describe a learning resource adequately, and this task will be facilitated if the learning object in question is already explicitly linked to ontologies and this can be exploited. These attributes and their values form a vocabulary, which could be captured in terms of an ontology to enhance the description and discovery functionality. Ontology considers relationships between all resources and how to arrange meta data classes into hierarchies.

Annotation is another form of attaching information to an existing resource. Ontology technologies can make the inherent knowledge structure of content explicit. Taxonomy and thesaurus functionalities are used here to support the markup, in particular the definition of tags.

Content Adaptivity and Presentation: Adapting learning requires the matching of learner knowledge with knowledge represented in content. The two traditional forms of adaptivity that have been useful for the adaptive presentation of content are layout and navigation adaptivity. Ontology based content organization can enhance the variety of forms and the degree of adaptivity of delivery.

Content Organization and Sequencing: Knowledge about a collection of learning content units can be used to organize individual units into a larger learning object by sequencing the units based on inherent dependencies that are derived from the knowledge. Knowledge captured in the form of ontologies can support the organization and sequencing of units.

Interoperability and Packaging: Interoperability is the ability of two or more systems or components to exchange information and to use the information that has been exchanged. Ontology allows all interoperating systems to specify meanings of terms with precision, by linking terms used in specific contexts to the ontology elements that describe the meanings of those terms in logical format. If several developers in a domain are using the same ontology to describe their domain then it enables their systems to interoperate much more easily.

Interoperability of educational resources is only possible if the content resources are packaged in a widely accepted and supported format. The IMS Content Packaging (CP) standard aims at providing interoperability of Internet-based learning content with content creation tools, learning management systems, and run-time environments. XML technologies provide an education-specific notation to assemble content units (resources) and organize them through hierarchical, educationally sound content packages.

Exchange and Sharing: Sharing and exchanging refers here to a technical context, where content objects remain under control of the creator or owner and resources are assumed to be fully (physically) available to potential users.

Reasoning: Reasoning means deriving facts that are not expressed in ontology explicitly. New relationships can be declared and derived using reasoning rules by formal semantics. Formal semantics allow this to be done declaratively and thus processed by generic programs. For example, rules for synonyms enable a system to go from lexical searches to semantic searching.

VII. CONCLUSION

The Semantic Web is the emerging technology aiming at web-based information and services that would be understandable and reusable by both humans and machines. The Semantic Web has opened new horizons for internet applications in general and for E-Learning in particular. This paper discussed the significance of semantic web in E-Learning content and the use of ontology in developing E-Learning content. Tools, languages, steps and approaches for ontology development are also discussed. By focusing on ontology in content infrastructure realize E-Learning community to have much more effective services than what is currently provided by any of the available computer aided tutoring, or learning management systems.

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