Czech University of Life Sciences in Prague

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Approaches of Semantic web in E-Learning

Bachelor Thesis

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BACHELOR THESIS ASSIGNMENT

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Informatics

Thesis title

Semantic web in information management

Objectives of thesis

Main objective of bachelor thesis is how Semantic web is utilized in Information Management for Education.

Partial goals of the thesis are:

- To identify the best approach available in E-learning using Semantic web.
-To identify the effectiveness of Semantic web E-learning.

Methodology

Methodology of the thesis is based on study and analysis of specialized information sources. For own solution this study has incorporated, study of different semantic web ontologies in E- learning in Education system. Based on a synthesis of theoretical knowledge and the results of own solution, the conclusions of the thesis will be formulated.

Schedule for processing

1. Preparation and study of specialized information resources, refinement of partial goals and selection of work process: 06/2013
2. Processing of collected information: 07 - 10/2013
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4. Submission of thesis and abstract: 03/2014

The proposed extent of the thesis
40 - 50 pages of text.

Keywords
Semantic Web, RDF, Ontology, SPARQL, e-learning

Recommended information sources

GHALEB, Fayed, Sameh DAOUD a Ahmad HASNA. E-Learning Model Based On Semantic Web Technology. 2006. Dostupné z: http://www.ijcis.info/Vol4N2/pp63-71.pdf.

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Declaration

I declare that I have worked on my bachelor thesis titled "Approaches of semantic web in e-learning" by myself and I have used only the sources mentioned at the end of the thesis. As the author of the diploma thesis, I declare that the thesis does not violate copyrights of any third person.

In Prague on: 17 March 2014

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Approaches of Semantic Web in E-Learning

Abstract

The technology is demanding the easiest and convenient way to operate the basic information on the overall technology. Semantic web is a vision which has data on the web with well-defined and linked in such a way that it can be used by machines not only for purposes display but also for reuses, automations and combinations of data across various applications. The main objective of this thesis is to identify the utilization of semantic web in information management for education and also to show how semantic web is related and linked with learning management system. The research is divided into two parts. The first part of the study is based on MADM (Multiple Attribute Decision Making) the experts evaluated several frameworks like Apache Stanbol, Sesame, Jena and Cubic web to given criteria. Similarly, in the second part SWOT analysis was used as a case study to identify the effectiveness of semantic web and e-learning. The result shows that the value from Sesame has been matched and semantic was found the best for e-learning. Finally, the research concludes that Sesame is the best semantic framework for e-learning and semantic web can be extremely beneficial for the development of e-learning.

Keywords: Semantic Web, E-Learning, HTTP, API, W3C, RDF, OWL, SPARQL

Abstrakt:

Současná technologie vyžaduje snadnější a praktičtější způsoby pro fungování základních informací v rámci celkové technologie. Sémantický web je myšlenka, kde jsou údaje na webu definované a spojené ve způsobu, který může být použit stroji nejen pro účely zobrazení, ale také pro opětovné použití, automatizaci a integraci dat napříč různými aplikacemi. Hlavním cílem této diplomové práce je určit využití sémantického webu v oblasti systému informačního managementu pro vzdělávání a také ukázat, jak sémantický web souvisí se systémem vzdělávacího managementu. Výzkum je rozdělen do dvou částí. První část této studie je založena na MADM (Multiple Attribute Decision Making), odborníci hodnotí několik softwarových struktur jako Apache stanbol, Sesame, Jena and Cubic web podle zadaných kritérií. Podobně v druhé části SWOT analýzy byla použita případová studie k určení efektivnosti sémantického webu a e-learningu. Výsledky ukazují, že hodnoty ze Sesame se shodují a sémantický web byl shledán jako nejlepší pro e-learning. Konečně, výzkum potvrdil, že Sesame je nejlepší softwarová struktura pro e-learning a sémantický web může být extrémně prospěšný pro rozvoj e-learningu.

Klíčová slova: Sémantický web, e-learning, URI, HTTP, API, W3C, RDF, OWL, SPARQL

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1 Introduction

Nowadays education has become one of the basic needs for human beings. Learning refers to acquiring or gaining knowledge with the help of different source, either it can be a book or by using electronic devices. As the time is changing rapidly, the use of e learning is also growing with the modern technology. The advance technology is not keeping the boundaries on the normal web. The technology is demanding easiest and convenient way to operate the basic information on the overall technology. Another name through which the modern technology is getting faster and relevant form is the representation of semantic web. Semantic Web is not a separate but it is the extension of the current web where information provides well defined meaning, to work in cooperation. Semantic web is a vision which has data on the web with well-defined and linked in such a way that it can be used by machines not only for purposes display, but also for reuse, automation, and integration of data across various applications. (1)

When we talk about the semantic web in context of e learning, it can be concluded that e learning is one of the essential and beneficial segment and it requires a deeper understandings of the relevant issue. E-Learning is widely applied, it's necessary and urgent to solve the problems in E-Learning applications, and among them learning resource sharing is one of the core problems. As web technology is slowly getting mature and widely accepted, learning resources are becoming more common means of publishing and sharing information through Internet. At the same time with the changes of these learning resources, the changes of framework also can be seen. Frameworks help to support the development of dynamic websites, application, services and resources of the web and related to the web. The study focuses on the learning management systems based on semantic web technologies. (2)

2 Aim and methodology

The main objective of this thesis is to identify the utilization of semantic web in information management for education and also to show how semantic web is related and linked with learning management system. The partial objective of this thesis is to identify the best approaches available in e-learning using semantic web. It also analyzes the effectiveness of semantic web for e-learning.

Methodology of the thesis is based on study and analysis of specialized information sources. For own solution this study has incorporated study of different semantic web ontologies in e-learning in education system based on a synthesis of theoretical knowledge and the results of own solution. In the first part of this research, MADM (Multiple Attribute Decision Making) is used to compare the best open source framework from selective semantic framework. As well as the method like AHP (Analytical Hierarchical Process) is also used for the comparison of pairwise and find which part of criterion attribute is the most important for choosing any semantic framework. The analysis is made among Apache Stanbol, Sesame, Jena and Cubic web.

Secondly, the research tries to determine the work of semantic web with e-learning by using SWOT analysis. The elements like strength, weakness, opportunity and threats of SWOT analysis are used in case study.

3 Literature review

In this chapter, the focus has been made on the review of literature relevant to the approaches of semantic web in e-learning. The main purpose of review of literature is to discuss and overview the utilization of semantic web in information management. In this modern and challenging world, new styles of learning is one of the most challenging in every field and for every industry, in the same way everything in web is being possible by the help of semantic web . E-learning replace old fashioned time, place content prearranged learning with in time. There is no doubt that, the requirements of the new economy has driven new style of learning.

The first concept of semantic network model was developed in 1960s together by three contributors Allan M Collins, M Ross Quillian and psychologist Elizabeth F Loftus in various publications. But he was Tim Berners-Lee, who composed the term semantic web for a web of data that can be operated by machines. (3)

3.1 What is Semantic Web?

Semantic Web is a web of data. We are using lots of data every day and it's not part of the web. (4) For example, we can see our photo, we can see our bank statement and we can see appointment, meeting and birth date in calendar. But can we see ours photos, bank statement lines in same calendar? Why not? Because we don't have web of data and all data is controlled by applications and each application keep it to itself. Main Vision of semantic web is to extend principle of web from document to data and data should be accessed using the general web architecture related to each other. It means the creation of a common framework that allows data to shared and reused across application, enterprise and community boundaries to be processed automatically by tools as well as manually including revealing possible new relationship among pieces of data. (5)

According to Berners-Lee, Hendler and Lissila (6) most of the web contain is designed for humans to read, not for computers program to manipulate meaningfully. Computers will expertly analyze web pages for layout and routine which process here a header there a link to

another page but, generally, computers don't have reliable way to process the semantics or the meaning of the content of the page. (6)

There are many different views and ideas about what the general vision includes. An almost overpowering number of various ideas exist about the supposed nature of the semantic web, and that can be the first lesson to learn. (5) The semantic web is like fluid, developing, informally defined concept rather than combined working system. Here are some quotations about the nature of the semantic web:

3.1.1 Machine readable data view

The idea of semantic web is to have data on web defined and linked in such a way in which it can be used by machine not only for display purposes but also for integration, automation and reuse of data through the various types of applications. (7)

3.1.2 Distribution data views

The concept of the semantic web is to do what HTML has done for textual information system for data and to provide adequate flexibility to be able to characterize all the logical rules and all the databases together to link them to great value added. (7)

3.1.3 Intelligent agents view

The semantic web aims to make the current web more machines readable to allow intelligent agents to recover and operate relevant information. (5)

3.1.4 Automated infrastructure view

According to Scientific American article Berners-Lee argues that the semantic web is infrastructure and not an application. (6) So the actual difficulties are not having the sufficient easy automation framework in the present web. (5)

3.1.5 Servant of humanity view

The idea of the semantic web is to let computer software relieve much of the burden of locating resources on the web that are relevant to our needs and extracting integrating and indexing the information contained within. (8) Semantic web is the dream of the next generation web, which enables web applications to automatically collect web document from diverse sources, integrate and procedure information and interoperate with other applications in order to implement refined tasks for humans. (5)

3.1.6 Better annotation view

The vision of semantic web (9) supplies the informal web as it is with annotations communicated in machine process able from linked together.

3.1.7 Improved searching view

The main objective of semantic web is to build a structured index of the web site which makes now a day the search engines are getting intelligent than before, and more easily to search.

3.1.8 Web service view

Semantic web provide access not only to static document for collecting useful information but it also provides service to useful behavior. The semantic web will expands the services for the existing web by allowing software agents to make the process systematic which is performed presently, manually and by introducing new application that are infeasible today.

Now, these notions make clear that the Semantic web covers a lot of ground and may be different people have different idea about it. (5)

3.2 E-Learning

The word e-learning is derived from the word learning, in which different electronic media and information and communication in education are used. It is a means of education which develops self-motivation, communication, ability and technology. Students should keep motivated by themselves because there are limited social interactions. E-learning is very broad and includes all the forms in teaching and learning of educational technology.

Since 2000 e-learning market has reached to 90%. E-learning is more than just of online course. Nowadays there are over 19 million online students. E learning has debate forums and chats for students to exchange information and solve problems as quickly and easily as possible. Video conferencing is also available so that student can have tutorial sessions with teachers watch and listen to a live class or even watch past classes with the help of the video streaming. E-learning is interactive multimedia learning aided by games and activities that strengthen the students' knowledge with very visual and entertaining exercises. With the e-learning students can train for very difficult tasks thanks to its virtual environment in a very safe and inexpensive manner. E-learning also stands for resource optimization. (10)

3.3 Advantages of E-learning

- It is Affordable, time saver and can produce measurable readers
- It is flexible, accessible and convenience
- students are able to get information according to their personal situations and needs
- E-learning accommodates different types of learning styles, that is why students like e-learning
- It is effective as well as saves money from travelling
- Class can be taken any time any where
- It helps student to knowledge of the interest

3.4 Disadvantage of E-learning

- Learners needs computer and internet to operate
- Only limited and computer skilled person can use
- E-learners should have good writing and communication skill
- The feeling of isolated can be seen in the students
- It is expensive than normal learning
- People having low vision power can be disadvantaged
- Requires strong self-motivation and responsibilities

3.5 How does semantic web work with E-learning?

Semantic web is web of data similarly, e-learning is the process of learning from internet by using web through which we get knowledge about something that we need, Now a days e-learning user are increasing day by day with the changes of the developing technology. In internet web distributes the knowledge that benefits e-learning and they are linked to commonly agreed ontologies which implement development of user specific codes by semantic querying for topic of interest. (11)

3.6 Semantic Web

The semantic is related to syntax, in most languages syntax is how you say something where semantics is the meaning behind what is said. While talking about syntax and semantics, what really can be talk about is communication. The internet created the standard way for computers to communicate with one another. In other words, it gives a voice to a computer so that they can talk to each other and exchange information. It is somehow like birds can mimic human sounds without understanding them, computers mimic human information to one another. So, while the internet enables computers to talk to one another, it was not designed to teach them what the information actually means. Web is accused document storage in a retrieval system. When the websites address entered in browser, it sends the request to the websites the request basically states that the document located at the address that gave. The website reads a document sent it back to web browser, this document is written in a language called HTML. The HTML language defines a syntax at computers can understand. It tells computer how to display the document. So, the two really need things set the web did is create a way to get any document in the internet and it also created a syntax called HTML that is used to display the document. So, there is internet that lets just talk to each other, there is a web that lets a store and retrieves any document on the internet and there are search engines which helps to find any information from any web. The web is already good and the semantic is making it better. (12)
Computers today just blindly retrieve information they don't understand the meaning behind the web pages that they are showing. While they understand the syntax the semantics are lost on them. If computers recognize what is in a web page, they could learn what users are interested in. If they know that they can help to get what users want, they would change from passively helping users to actively helping users. This is what the semantic web is all about. Semantic web helps computers to understand the meaning behind a web page. (5)

The Semantic Web is the improvement of the World Wide Web (WWW) which was developed by Tim Berners-Lee that helps people to share contents from the different part of the world at the distance of dividing lines of applications and websites. It is explained in various ways, as a

web of data or merely as a natural paradigm shift in our daily use of the Web. Many people are involved by the inspiration of semantic web to setup new and developed technologies. (13)

The semantic web is like the document web, and it is based on some radical notions of data and information sharing in our daily life. Because of the large number of data created, it causes chaos which often creates confusion or disagreement and disorder in the web searches. That is why it is very necessary to find out such disorders and develop easier infrastructure which helps to make easy for information sharing, cooperation and collaboration. It can be used by machines not just for display purposes but for automations, integrations and reuse of data across various applications. (6)

3.7 Layers of semantic web

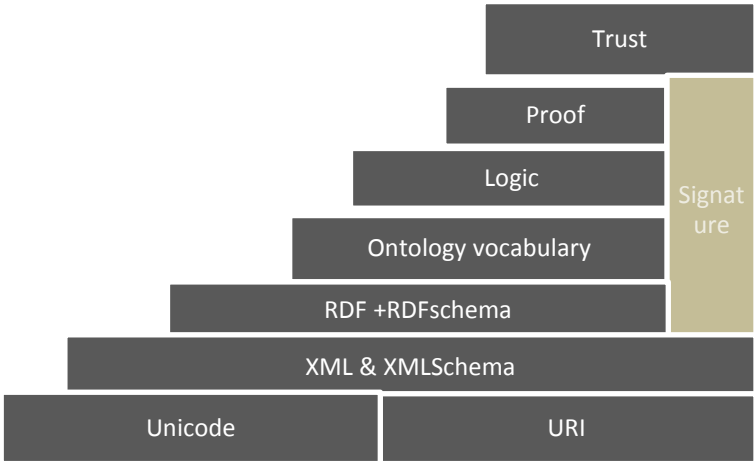


Figure 1 Layers of semantic web

(http://obitko.com/tutorials/ontologies-semantic-web/semantic-web-architecture.html)

The semantic web comes from Tim Berners-Lee and he is the inventor of WWW, URI and he also thought the concept of HTTP, HTML, XML and now the semantic web. He has been working on presenting the semantic web and getting people to understand semantic web for several years. Here, the Fig.1 shows the major concepts and ideas of semantic web purposed by

him, where a web can evolve around a collection of knowledge and allow people to add what they know as well as find answers to their questions. The unique thing about the semantic web is that it uses the structure form to be readable by people and machine. The table above shows the different layer of the semantic web. From the very bottom is Unicode and Uniform Resource Identifier (URI) and that is like name plate for everything which going to be captivated by web. The Unicode is a common code language which gives a computer number to literally character for every written language in the world. URI is basically a name which is the representation of entity some kind of resource of some web. Above the Unicode base is Extensible Markup Language (XML) and schema that everything goes with XML and the XML is going to be the common language with the connection of everything together. Using XML the schema semantic web was used RDF which is triplet that connected different object together. Then in the third layer, Resource Description Framework (RDF) will built ontology vocabulary with basic rules that tie on top with logic, which built on proof and knows how things work. And from the above figure all four layers RDF, Ontology Vocabulary, Logic and Proof, they all form digital signature so, the document is what it says it is and that follows to top layer which is trust. (14)

The examples can be concluded with the different information available on the web like weather information, Airplane times, sports, calendar and TV and movie guides etc. all the information can be found on web which is easy to see but they are very difficult to use. If anyone goes to the sports stats page and try to find the information, which is very difficult to get from the page so it can be utilized. Similarly, calendar can be taken as another example.

Now with the semantic web the grand vision is that the better web communication and personal communication. The desktop, laptop and server etc. are getting in codes much smarter. Everything is going to be connected but it's going to be connected in terms of relationship so instead of just technology there is relationship to see how thing inter play with each other. The automation of decision had to be processed in past are going to be much easier to hand over the semantic web. And also the ability to assess the trustworthiness of the documents on the web will become very powerful with the semantic web and ability to find information and relationships much faster and with greater ease. If the days of Google and other search engines are looked back in the 1990's, the vast difference can be found out because all we look for were a few keywords and got matches to those key words. (14)

3.8 The E-Learning System Framework Based On Semantic Web

Aiming at the existing problems in e-learning resources construction, from learning resources metadata Angle, semantic web has bright prospects. XML provides grammar supports for information exchange and sharing, RDF provides the metadata standards for describing resources on the web, and ontology solves the foundation on semantic level about information sharing and exchange on web. We can use the semantic web and ontology to improve current e-learning system framework. (15)

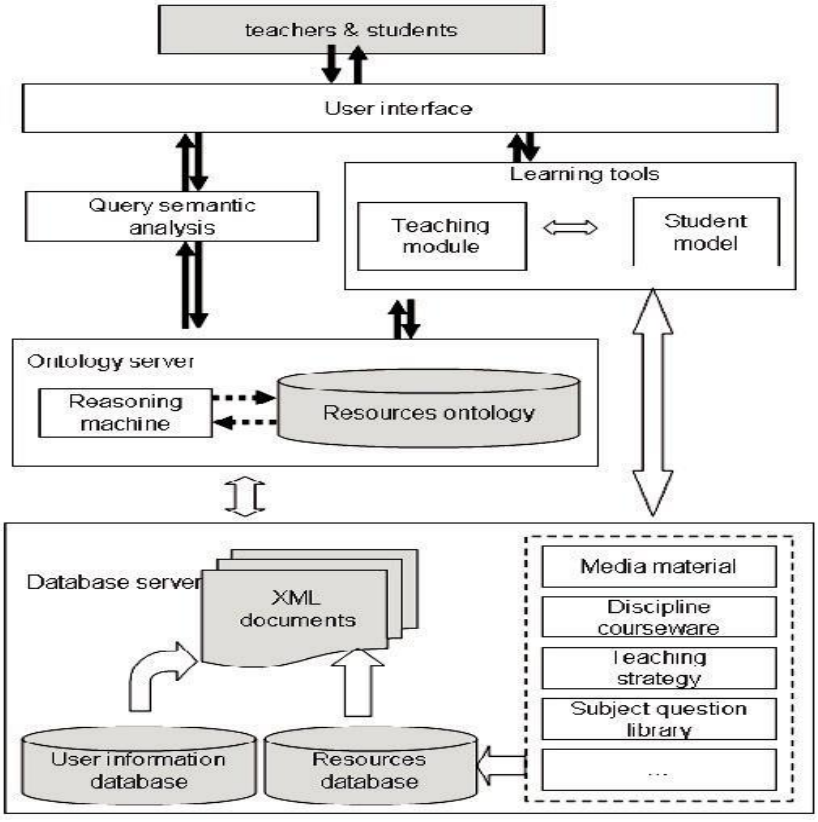


Figure 2 The E-Learning System Framework Based On Semantic Web

The developing e-learning system framework was based on semantic web. It is composed by the user interface resources query tools, resource ontology, learning tool, XML documents, as

well as various resources. The system framework fully embodies the thought of semantic Web framework. For the ontology description of learning resources, forming the ontology, corresponding to the ontology layer of semantic web above part of ontology server is various operations of collaborative learning, resources retrieval and sharing etc. corresponding to all layers above the ontology layer in semantic web below

Part of ontology server includes various resources and a large number of XML describing documents, corresponding to each layer below the ontology layer in semantic web. (16)

According to the CELTS (Chines E-learning Technology Standards), ontology repository includes user information database and resource database. User information database is the expansion of learner's records library in CELTS specification. The knowledge ontology be formed by the knowledge that gained In self-study and collaborative learning process can be used as a supplement to ontology repository, in collaborative learning process, knowledge ontology is recorded as the content and result of group learning, it can make others convenient understand the group learning schedule and roughly content. (15)

Resources query is based on ontology layer, it makes full use of the characteristics of semantic mechanism, retrievals ontology accurately and fast, provides learning resources for the system users. Learners in the course of study can use and share resources ontology, attain consistent comprehension, be helpful for learning effect.

3.9 Semantic Web in E learning

The Semantic Web brought a new idea to setup a new form of web content with a meaningful to computers. Many technologies had been invent and developed for constructing and improving in the Semantic Web. RDF and its expansion and enlargement like OWL were developed to define metadata domain ontologies, schemas and resource descriptions.

The Semantic e-learning environment needs the provision of learning and understanding contents in various formats. It is necessary for semantic based annotation for e-learning material to make easy re-structuring of the e-learning framework, and individualized delivery of the semantic e-learning material. (11)

The conceptual design in terms of e-learning of the content is always an important part of the learning stuff. The actual meaning of unsuccessful contextual data of content is that, students cannot not be able to contextually combine and mix the concepts that they wanted to learn, which is highly important to achieve knowledge and understanding of any subject area. Therefore, it is important that the Meta data must be and comprehensible for both the human and machine which absolutely will form a major part of the components of the communication system in e-learning. Semantic web is the recent effort for web community, is a technology for developing semantic ability to exchange and use information of e-learning components. The main part of the semantic web is the domain ontologies which should describe the normal explanation for a shared domain conceptualization. (17) Like as semantic Web, the new generation web has better situation for composing and reusing e-learning contexts and materials. The semantic web can be an opportunity associated to e-learning materials to enhance the metadata, increasing the possibilities of e-learning description and standards. The ontology control of e-learning environment has to represent and model the applicable aspects and domains of knowledge which contains the knowledge about

- Domain
- Students
- Learning objective
- Process of learning and
- Communication

The aspects of above knowledge can be supported by the general concepts which are implemented as elements of e-learning architecture. Meta data are data about data. Semantics are more important in the emerging area of e-learning. Extension and development of the Semantic Web provides semantic information to the machine as well as conceptual information for the human user to understand. According to the result of the semantic web, it needs a Meta data architecture which is subjective and helps to support different views of the same resource, developing and supporting Meta data of e-learning. Semantic web is extensible by allowing the introduction of different new contexts and elements with new procedure of semantics, which have concept to make evolution of human behavior and knowledge.

On the other hand the e-learning domains are raising their standards for explaining learning resources, among them one of the domains is Learning Objects Metadata (LOM). For educational systems of managing learning objects of different kinds, LOM is gradually being the reference standard in todays world.

3.10 Semantic Web Technologies for E-learning.

The Semantic Web aims to add semantic information to web contents in order to create an environment where software agents can perform tasks efficiently. The Semantic Web proposes the idea that web contents are defined and linked not only for visualization but also to be used by applications. That is why the Semantic Web represents a promising technology to implement e-learning systems which shows that the Semantic Web meets the basic e-learning requirements namely speed just in time and pertinent learning. The appropriateness of Semantic web technologies for developing e-learning systems is also supported by the research work undertaken in the last years from different perspectives.

The Semantic Web has its aim to go beyond the limits of the current web by introducing explicit descriptions of meaning, the internal structure and the overall structure of the contents and services available on the WWW. Before the chaotic growth in resources and the absence of any clear organization in the web today, it advocates a classification, structuring and annotation of resources with exploitations that can be processed by semantic machine. (2)

3.10.1 Linked data

Semantic web is a web of data which use the web to create typed links between data from different sources. Generally, when we talk about the computing, linked data describes the system of publishing structure data that can be interlinked to make them more useful. When we talk about linked open data, what is it? And why is it good as a memory organization. Tim Berners-Lee, the inventor of the World Wide Web (www), put information as documents on the web. And lots of information today is available on lots of individual websites. Then in the next step forward he put information on the web as raw data because raw data can be linked to other data that generates connection for the user and puts them in touch with a much richer network of information, but to make that happen there are four things to do.

First, it helps if the data is openly licensed. If it's not open, it's not easily interoperable.

Secondly, put the data on the web in a certain way so that the connecting links are present in their simplest form and each of this links is represented using the Resource Description Framework (RDF) or triple because it's in three parts and all these triples will interconnect.

Thirdly, when they are online they need a unique address, a Uniform Resource Identifier (URI).

Lastly, put them online following the standard web resource protocol, HTTP and linked open data can be connected to all other linked open data creating a rich network of information making connection which never knew were there linking knowledge in way that's never been done before. (7)

3.10.2 Resources Description Framework (RDF)

RDF is a general purpose language for representing information in the web. RDF is a standard developed by World Wide Web consortium for the web metadata and it is a flexible schema-less data model. It is determined as one of the core technologies of the semantic web as well as the modern W3C standard directed towards data on web. It is useful to describe the web resource and also provides the ability to exchange and use information between applications which exchange machine acceptable information on the web. RDF has become widely accepted language and a representation formalism, which can serve as worldwide Interlingua for information interchange. RDF application is an application developed by the W3C for embedding RDF Meta data inside JPEG images. The application works like agreement with the W3C's jigsaw Web server to evoke automatically with the RDF Meta data from images stored on the server. RDF framework make possible for all user to share website and other descriptions more and more easily, And for the building of the products to software developers which can use the meta data for providing better search engines and directories, to perform as intelligent operator and to provide web user more control for which they are looking for.

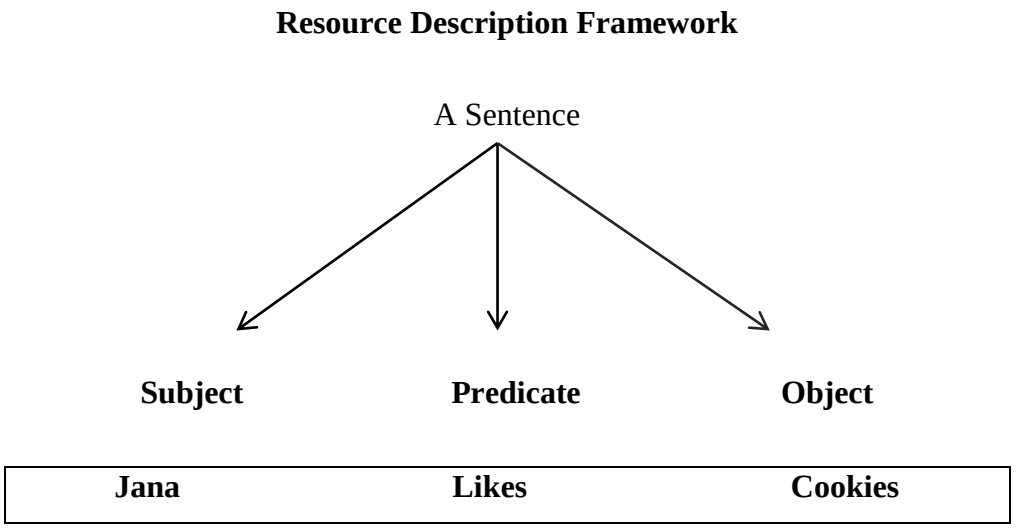
Various benefits can be point out if the information of the RDF is collected.

- RDF encourages and inspires the providing of metadata related to the Internet resources, by providing a logical framework
- RDF consists of a standard syntax for describing and querying data, due to which the software that experience metadata will be easier and faster to produce
- The standard syntax and query capability grants applications to share information and ideas more easily
- Seekers and viewers can get actual results from searching, based on metadata then that on indexes copied from full text
- The software agents that are intelligent have more actual data to work with

RDF graph is a collection of triples in which each consists of a subject URI, a predicate URI and of an Object. Adding semantic to web by using RDFa. RDFa is based on RDF, and in normal way, it can describe any concept, relationship or thing that exists in the universe. The idea behind RDF is very simple that is used to grasp. There are three things in RDF subject,

predicates and object. The subject refers to the thing which is describing, the predicate refers to an attribute of the thing that is describing and the object is the thing that referring to with the predicate. To understand this case more, here is statement which describe clearly like “Jana likes cookies” where “Jana” is subject, “likes” is predicate and “Cookies” is object, which is basically what RDF do in a simple concept that can describe anything.

Figure 3 Resource Description Framework



3.10.3 Triple Store

Triple Store is one of the frameworks that is used for storing and querying RDF data which provides a mechanism for storage and access of RDF graph. The representation of data in the form of a graph lends itself will to structured data with a dynamic schema. It is a data base management system for data modeled using RDF which stores data in relations. The major feature of most of the triple stores is the ability of interpretation. The development of triple stores has increased from Jena and Sesame in the early 2000s.

Triple store is like a synonym for an RDF sore. All data can be placed in one table with three core fields i.e. triples. The reason behind designing a triple store is to store and recover identities which are constructed from the triplex collection of strings, and triplex collection represents the relationship of subject, predicate-object more or less like in RDF. The first and optional part of triple is the subject, the predicate and object is compulsory. RDF data can import, export and render triple store by hand, HTTP/WebDAV GET and PUT, Transformation of XML to RDF via XSLT, transformation of SQL data to RDF through virtualization.

There are three categories of triple store which is classified below:

Table 1 Categories of Triple Store

Name	Native Triple Store	RDMS-backed Triple Store	NoSQL Triple Store
Description	Implemented from scratch and exploit the RDF data model for storing and access the RDF data	Built by adding and RDF specific layers to an existing RDBMS	Being investigated as possible storage managers for RDF
Includes	4Store, AllegroGraph, BigData, Jena TDB, Sesame, Stardog, OWLIM, uRIKA	Jena SDB, IBM DB2, Virtuoso	Cumulus RDF

3.10.4 SPARQL

SPARQL stands for Simple Protocol and RDF Query Language. It is the standard query language for RDF, similarly the way SQL is standard query language for relational database. In 2008 the first version of SPRQL 1.0 was standardized, and used in RDF database query. SPARQL is as like as query language with a number of essential and powerful additions which include the capacity and ability to filter result and create new graphs based on queries. SPARQL queries effort to match designs in the graph and bind wildcard variables as it finds clarifications. (9)

3.10.5 OWL

Owl is a web ontology language where earlier languages are used for the development of tools and ontologies for distinct user communities especially in the sciences and in company specific e-commerce tools. They were not described to be adaptable and suitable with the architecture of the World Wide Web in general and the Semantic Web particular. (7)

Owl use URI and Description Framework both for naming and for the web provided by RDF respectively. Following are the capabilities that can be added to ontologies.

- It has got capability to be distributed across many systems.
- It has ability of a system, network or process to handle Web needs.
- It is consistence with Web standards as well as easy to appreciate or understand.
- It is openness and extensibility and flexibility.

RDF and RDF schema creates OWL, which add more properties for describing vocabulary and classes. (7)

3.10.6 XML

XML stands for Extensible Markup Language and all of its capabilities. People really struggle to understand exactly what XML is? XML is a Markup language and uses tags to construct a very specific document structure. It is not limited to the web and can be opened in any software package that recognizes it. XML does not care how the elements are displayed. XML separates the content into smaller descriptive pieces. It is not limited to any fixed set of tags, or types of elements. XML does one thing really well, that it organizes and classifies data so that it is useable by a wide range of devices and software packages. (7)

People use XML because:

- It easily allows transferring data between multiple different devices and software platforms. It is somehow like universal translator
- Advanced XML is set up to facilitate transfer of information in multiple different languages and character sets
- As many different tags can be made with specified attributes as needed
- The data is easy to extract from XML, because it is so well organised
- XML works with powerful web technologies such as HTML, CSS, JavaScript, Databases etc.
- XML data is easy to understand because of the focus on organization
- Search engines can provide the best results when deep XML definitions have been applied to data
- It provides web developers with the ability to change data site wise, instead of page by page basis

Extensible Markup Language helps information systems to share structured data. It is a Meta data language, which gives meaning to data that other applications can use. Applications and platforms of XML are independent which allows various types of structure and semi structure data. It is extensible to accommodate new tags and processing methods can be created and allows user to define tags. (7)

3.11 Semantic Web Ontologies

In semantic web ontology is defined as a data model that represents knowledge as a set of concept with in a domain and the relationship between these concept. Ontology is a form of knowledge management, it captures the knowledge with in an organization as a model, this model can create series to answer complex question and display relationship across the enterprise. Today people have access to more data in a single day then most people have access to in a lifetime in previous decades, the problem is the date is found in many different points. All of this information captured in many different formats makes almost impossible to understand existing relationship between different data. In this current environment it is very difficult to determine how policies captured and were documents related business process is captured and modeled? And how does business process these related data captured in the data base? Data needs to be represented in a format that allows these types of relationship to be discovered. Ontologies captured data in a way that allows this relationship to become visible. The two standards that govern the construction of ontologies are RDF and OWL. In accordance with RDF and OWL ontologies are made up of two main components classes and relationship. Classes are represented as ovals or relationships are represented by arrow.

Figure 4 Components of Ontology

For example there are two classes one is person and another is university, it represents a real world concept there is also relationship i.e. has student. Together this classes and relationship can be combined to assert statement about the real world. In this example below, the class person is related to the class university to the property has student.

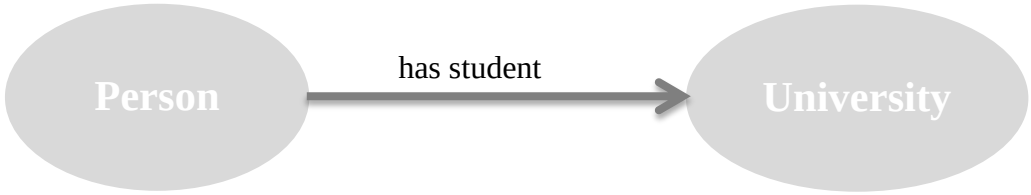


Figure 5 Examples of component of ontologies

The combination of classes and relationship is known as triple consist of a subject predicate object. Triple is like a heart of ontologies. They can be merged together to provide a comprehensive view of the real world within an ontology. Within an ontology concepts are only define in terms of their relationship to other concepts. As example below, Person has many relationships to other concepts including gender, birth date, race, nationality, address

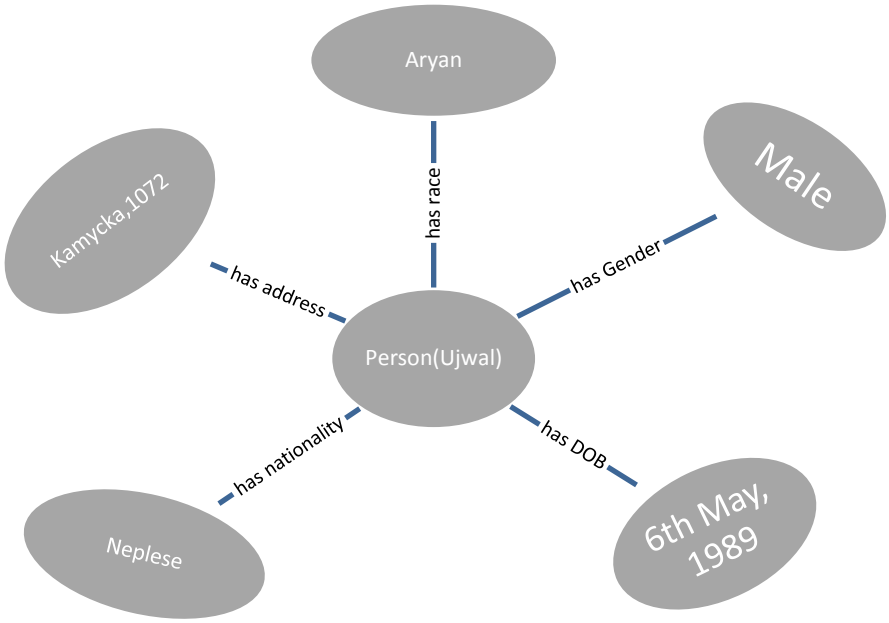


Figure 6 Triple concept RDF

Ontologies are also easily extensible, rather than rewriting lines of code relationships can easily be added to existing ontologies. Simply the additional relationships can be added between people to new concepts. This process continues in ontologies extended without disrupting the work is ongoing RDF complete. One of the most popular aspects of ontologies in additionally

captured relationship is the using ontologies for knowledge management is an alternative to source code. Many approaches captured knowledge in relationship established by different working groups as lines and lines of source code. This approach is still popular and extremely hard to manage which can be managed only by a small group of engineers who understand the codes and cannot easily adapt to changes in the environment. Ontologies present in new method in managing knowledge, capturing relationships courage more individual to become directly involved. Using models rather than lines of code also allows the ontologies to be easily modified with the changing environments. This makes ontologies a sensible choice.

4 Practical Part

4.1 Practical Part (Comparison of semantic web framework in E-learning)

4.1.1 Apache Stanbol

Apache Stanbol is a free and open source framework for building semantic technologies to content management system platforms. The frameworks are composed of different APIs which interacts together to process data. It provides a set of reusable components for semantic content management. (18)

4.1.2 Sesame

Sesame is also an open source framework used for querying and analyzing RDF data. This includes implementations of an in-memory triplestore and an on-disk triplestore also with two separate servlet packages that can be used to manage and provide access to this triple store on a permanent server. It provides support for two query languages SPARQL and SeEQL. (19)

4.1.3 Jena

Jena is an open source semantic web framework for java which provides an Application programming interface to extract data from and write to RDF graphs. Graphs are represented as abstract model, that model can be sourced with data from files, database, URL or combination of this model can also be queried through SPARQL. (7)

4.1.4 Cubic Web

Cubic web is a framework that motivates developers to effectively build web applications by using components again and again known as cubes and following the well-known object-oriented design principles. Cubic Web is an engine driven by the explicit data model of the application. It has capacity and flexible power of the Python programming language. It provides support for a query language named as RQL. Cubic Web can be proved end to end solution for the development of semantic web application which helps in promoting quality, ability to reuse and efficiency. (7)

4.2 Multiple Attribute Decision Making (MADM)

MADM is the process for making decisions in the selection of methods or courses of action from available alternatives, which are characterized by multiple attribute.

As defined by international society on MADM is the study of method and procedure concerning multiple conflicting attributes which can be formally incorporated into the management planning process, Multiple Attribute Decision Making includes following steps.

Setting Goal- A goal of a company or any particular individual (interest group) attempts to achieve. (20)

Criteria identification decision maker should determine the character of the analyzed problem. It's needed to confirm specifically those criteria to be thought about and which of the decision making ways are to be employed. Open source framework is major famous framework in current semantic framework application for e-learning. This research is based on the criteria to be chosen for popular open source framework that is the best open source framework from the selected semantic framework. In order to know best way to choose the open source semantic framework the research is made based on the Multiple Attribute Decision Making among five experts. The criteria are Manageability, Extendibility, usability, portability and Performance given in this below table. The standard ranking given was from 1-10. And from their view

MADM

Table 2 Matrix form given by 5 experts from research

	Manageability	Usability	Extendibility	Portability	Performance
Apache Stanbol	6	5	6	8	9
Seasam	8	7	8	9	8
Jena	7	8	6	7	8
Cubic web	6	7	8	7	7
	max	max	max	max	max

There are some process and method in MADM like:

- Scoring or sequence methods
- Standard level methods
- Simple additive weighting method

Attributes must be measured in the same scale (here the scale is 1-10). (20)

Selection and description of software

As the objective of this thesis, some open source semantic framework were selected, it is because these Frameworks are most popular in current semantic framework. Apache Stanbol, Seasam, Jena and Cubic web are four most popular frameworks. This all are open sources and built on java and python Programming language. In terms of features extendibility, manageability, portability, performance and usability are importantly and particularly differ. Even though Apache Stanbol, Sesame, Jena and Cubic web are built on the similar technology, their characteristic and ability are different. Above table shows the ranking scale among five experts. To show which attribute plays important role in selection of the best open source software among different alternatives the standard method is selected. To describe and elaborate Standard level method given by expert is shown in the following table, According to the standard weight.

Table 3 Standard weight

Standard weight	8	7	8	9	8	40
Software	Manageability	Usability	Extendibility	Portability	Performance	Total
Apache stanbol	6	5	6	8	9	34
Seasam	8	7	8	9	8	40
Jena	7	8	6	7	8	36
Cubic Web	6	7	8	7	7	35
	Max	Max	Max	Max	Max	

According, to the value provide by expert, Sesame got the exact criterion value as the standard weight with standard score. But to sort out the exact evaluation on why expert chose Sesame as the best semantic framework for e-learning were analyzed according to AHP (Analytic Hierarchy Process).

4.3 AHP Model (Analytic Hierarchy Process)

AHP is one of the multiple criteria decision making approaches which was originally introduced and developed By Prof. Thomas L. Saaty (1977). It provides procedures of judgment, derives preference among criteria and option and simplifies preference ratings among decision criteria using pair wise comparisons.

4.3.1 Steps

- Decomposing the decision-making issue into a hierarchy.
- Making pair wise comparisons and establish priorities among the elements in the hierarchy.
- Synthesis judgments in order to obtain the set of overall weights for achieving goal. Analytical Hierarchy Process (AHP) Matrix to analyze open source framework from the view of software experts.

Analytical Hierarchy Process Matrix to analyze open source Framework from the view of experts. (20)

Table 4 Result from AHP

	Extendibility	Managibility	Usability	Portability	Performance
Extendibility	1	5	7	9	9
Managibility	0.2	1	7	8	8
Usability	0.142857143	0.142857143	1	7	5
Portability	0.111111111	0.125	0.142857143	1	9
Performance	0.111111111	0.125	0.2	0.111111111	1
COL. TOTAL	1.565079365	6.392857143	15.34285714	25.11111111	32

Table 5 After Normalization

CTQ'S	NORMALIZED SCORE Extendability	NORMALIZED SCORE Managibility	NORMALIZED SCORE Usability	NORMALIZED SCORE Portability	NORMALIZED SCORE Performance	CUMULATIVE NORMALIZED SCORE OR ROW SUM	NORMALIZED PERCENTAGE OR PERCENT RATIO SCALE OF PRIORITY
Extendability	0.638945	0.78212291	0.456238	0.35840708	0.28125	2.516963579	50.33927158
Managibility	0.127789	0.15642458	0.456238	0.31858407	0.25	1.30903606	26.18072119
Usability	0.091278	0.02234637	0.065177	0.27876106	0.15625	0.61381223	12.2762446
Portability	0.070994	0.01955307	0.009311	0.03982301	0.28125	0.420930983	8.418619665
Performance	0.070994	0.01955307	0.013035	0.00442478	0.03125	0.139257148	2.785142959
COL. TOTAL	1	1	1	1	1	5	

Normalized Percentage or percent ratio 50.339271 58 % of Extendibility mentioned by the data.

4.4 **Case study**

4.4.1 SWOT Analysis for semantic web

SWOT analysis is an approach which is used to evaluate for strengths, weaknesses, opportunities and threats. SWOT analysis can be helpful to achieve goal, vision. As we all know the path to success is not an easy. It is followed by obstacles and challenges, but success is achievable and SWOT analysis is one of the options which can help on the journey. SWOT analysis is an approach and planning tool which is used to evaluate all the factors that will affect the achievement of a project or business venture. The creation of a SWOT analysis model is attributed to Albert Humphrey who was a management consultant who worked in the latter half of the 20th century. His model can be used for any venture like individual, business or organization. One of the many values is that it focuses on identifying all of the factors internal and external, positive and negative that will affect the achievement or the vision are the goal.

	Helpful	Harmful
Internal	**Strengths**	**Weaknesses**
External	**Opportunities**	**Threats**

Figure 7 SWOT Analysis

4.4.2 Elements of SWOT Analysis

4.4.2.1 Strengths (Today)

a) Web distributes the knowledge items which can be very beneficial for e learning but they are linked to commonly agreed ontologies, these ontologies implement development of user specific codes by semantic querying for topic of interest.
b) W3C has an excellent reputation for creating useful standards (HTML, XML, XML Schema etc.)
c) Widespread acceptance in academic institutions worldwide.
d) Few alternative technologies with same breath and ambition.

4.4.2.2 Weaknesses (Today)

a) Few cost effective tools for many areas.
b) Proof logic and trust layers still in research and development stage.
c) RDF perceived as too complex or conflicting with XML (RSS example)
d) Perception that web sites need to be published in both human and machine readable version doubling costs.
e) Few published case studies with documented ROI.

4.4.2.3 Opportunity (Future)

a) Automated metadata discovery could become cost effective.
b) Automated integration requires ontologies.
c) IT departments spend billions each year on integration.
d) Business Intelligence or Analytics or Data warehouse require precise semantics.
e) Business rule engines need precise semantics.

4.4.2.4 Threats

a) Many incompatible mini standards.
b) Complexity
c) Vendor specific solutions
d) Complex XML structure (XLink, XPath)
e) Confusion with other standards (XML,CWM, ISO-11179)
f) One big Wikipedia takes over the entire World Wide Web and adds semantic features.

4.4.3 Suggestion

Semantic web is the developing technology designed at web based information and services that is reusable and understandable by both humans and machines, it open new perspective for internet application generally and for e learning particularly. SWOT analysis has been used as a case study to identify the effectiveness of semantic web and e learning. It is not simply enough to identify the strength, weakness, opportunity and threats of the semantic web in e-learning, but with the respect of the SWOT analysis it is important to avoid or remove both weakness and threats. Weakness should be converted into strengths similarly threats should be converted into opportunity. From this case study it can be concluded that semantic web can be extremely beneficial for the development of e-learning.

5 Result and Discussion

The main and major contribution of this thesis is modern technology for e-learning system using the semantic web. The technology is demanding the easiest and convenient way to operate the basic information on the overall technology. Semantic web can be the best web to operate the basic information in the present world.

A list of the technologies used in the implementation of semantic web based e-learning system includes RDF, OWL, SPARQL, Triple Store, Link Data and Ontology. In this thesis the RDF, OWL, SPARQL, Triple Store, Link Data and Ontology are well defined. RDF graph has been constructed to elaborate about triples and example of a subject URI, a predicate URI and an object is provided. The categories of Triple Store was classified into three groups as native Triple Store, RDMS backed Triple Store and NoSQL Triple Store.

Firstly, the survey is made among five web experts. Among them, the obtained data are analyzed according to semantic framework. For the description of semantic framework, manageability, usability, extendibility, portability and performance of semantic framework for e-learning are used as criterion. Some of the semantic frameworks like Apache Stanbol, Sesame, Jena and Cubic web have been explained with the value given by the expert. The value is in the scale of 1 to 10. Table 2 shows the average standard among experts. Each criterion of the mentioned semantic framework, maximum value is the best which shows that for each criterion maximum in the table above.

According to the standard level method from MADAM, in Table 3 the standard weight was created on top of table and compare with the standard value given by the expert about the semantic framework, where the value from Sesame has been matched and which shows that Sesame is the best semantic framework for e-learning.

SWOT analysis has also been used as a case study to identify the effectiveness of semantic web and e-learning. It is not simply enough to identify the strength, weakness, opportunity and threat of the semantic web in e-learning, but with the respect to the SWOT analysis it is important to avoid or remove both weakness and threat. Weakness should be converted into

strength similarly threat should be converted into opportunity. From this case study it can be concluded that semantic web can be extremely beneficial for the development of e-learning.

There is a saying by Tim Berners-Lee, “Web users ultimately want to get at data quickly and easily. They don’t care as much about attractive sites and pretty design”. Research of this paper gave the result that Sesame has a flexible architecture for storing and querying both RDF data and RDF schema and it has the best manageability, extendibility, usability, portability and performance in web technology. In e-learning most of all students and people who want information about something, they always want data or information quickly and easily. For users normally design of web doesn’t matter but, how easily and quickly the information can be obtained in a simple way.

6 Conclusion & Recommendation

Today internet is used for almost every work either it is for commercial purpose, entertainment, social network and also in very important purpose i.e. education. The environment of the learning has to support and maintain high forms of communication either between educator and learners or between learners. The internet can be used for teaching learning materials to get more knowledge which is called e-learning.

The first part of the study based on MADM the five experts evaluated several frameworks likes Apache stanbol, Sesame, Jena and Cubic web to given criteria. The criteria were extendibility, manageability, usability, portability and performance. In this research, standard level method was used to find standard weight. According to standard weight, the framework sesame was analyzed as a best open source framework among the selected four semantic frameworks. The comparison among criterion using AHP method was done as shown in Table no…. in which the result shows that extendibility was best among criterion.

In second part, SWOT analysis was used as a case study to identify the effectiveness of semantic web and e learning. SWOT analysis of the study shows strengths as well as it shows that there are some weaknesses which need to be improved in the future. Likewise, along with the opportunity there are some threats which need to be avoided or remove.

In this thesis the main objective was to identify the utilization of semantic web in e-learning. the objective of this research found that using the semantic framework in e-learning, can be more and more beneficial and effective services than that of currently provided by any of the convenient computer aided tutoring or learning management system.

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8 Abbreviations

RDF	Resource description frame work.
OWL	Web Ontology Language.
W3C	World Wide Web Consortium.
SKOS	Simple Knowledge Organization System.
SPARQL	Simple protocol and Resource Description Framework Query Language
HTTP	Hypertext Transfer Protocol.
API	Application Programming Interface.
GIGO	Garbage in, Garbage out.
LOM	Learning Objects Metadata
SWOT	Strength, Weakness, Opportunity and Threats.
MADM	Multiple Attribute Decision Model
JPEG	Joint Photographic Experts Group
URI	Uniform Resource Identifier
WWW	World Wide Web