Visual semantic web: ontology based E-learning management system

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DEDICATION

To my family, who is everything for me.
ABSTRACT

E-Learning is a process in which we use the electronic medium to access the defined set of applications and processes. With its increasing identification and recognition in academic and corporate world, a unique model or framework is required. E-Learning is a critical support mechanism for educational institutions to grow the performance of their students, teachers, as well as useful for organizations to enhance the performance of their employees. Semantic web represents a potential technology for realizing e-Learning requirements Research works in the field of e-Learning are represented by a wide range of applications, ranged from virtual classrooms to remote courses or distance learning. However, studies show that still it demands more effective approach. Ontology is a specification of conceptualization; the object, process, and other entities that are involved in making of the framework for E-learning. This thesis presents the ontology for E-learning process, such as course syllabus, teaching methods, learning activities and learning styles especially for Pakistan learning environment. This research is based on literature review and academic analysis. This paper presents the research design that will gather the information from academia for the implementation of my proposed ontology-based E-learning management system (O-BEMS).

Keywords: E-Learning System, Semantic web, Ontology.
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INTRODUCTION

Teachers face many difficulties when working with Information and Communication Technology (ICT) in education. Many of those problems are caused by the lack of conformity between the used technology and the educational requirements. E-Learning is efficient, task relevant and dynamically changing, distributed business world. It is clear that new ways of learning are some of the next challenges for every industry. Learning is a critical support mechanism for organizations to enhance the skills of their employees and at the same time useful for educational institutions. Therefore, learning process need to be more efficient. The aim of e-Learning is to replace old-fashioned learning process with efficient and on-demand process of learning, relevant to the user desires. E-Learning has its origins in computer-based training (CBT), which was an attempt to automate education, replace a paid instructor, and develop self-paced learning [1].

The current WWW is a powerful tool for research and education, but its utility is hindered by the failure of the user to navigate easily the reputable sources for the information he requires. The semantic web is a vision to solve this problem. It is proposed that a new WWW architecture will support not only Web content, but also associated formal semantics [2]. Semantic web is an evolving extension of the WWW in which web contents can be expressed not only in natural language but also in the form that can be understood, interpreted and can be used by the software agents (bots, spiders), thus permitting them to find, share and integrate information more easily. The essential components of semantic web are XML, XML schema (RDF/XML), RDF, RDF schema, OWL and SPARQL [3]. Extensive Markup Language (XML) provides a surface syntax for structured documents, XML schema is a language for restricting the structure and content element of the XML document. Resource Distribution Framework (RDF) is a simple data model for referring objects and how they are related; RDF schema is a vocabulary for describing properties and classes of RDF resources. OWL adds more vocabulary for describing properties and classes [3]. “Expressing meaning” is the main task of the semantic web. The basic layers of semantic web are; the XML layer, which represents the structure of data; the RDF layer, which represents the meaning of data; the Ontology layer, which represents the formal common agreement about meaning of data; the Logic layer, which enables intelligent reasoning with meaningful data [1].

The term ontology has been widely used in recent years in the field of Artificial Intelligence, computer and information science especially in domains such as, cooperative information systems, intelligent information integration, information retrieval and extraction, knowledge representation, and database management systems [4]. Ontology’s in the context of the semantic web are specifications of the conceptualization and corresponding vocabulary used to describe a domain [5]. Any semantic on the web is based on an explicitly specified ontology, so 2 different semantic web applications can communicate by exchanging their ontology’s. Several representation schemes have been defined for the ontology layer. The most popular one, the Ontology Interchange Language (OIL), combined with the DARPA Agent Markup Language (DAML), DAML+OIL, provides a rich set of language structures with which to create ontology and to markup information so that it is machine understandable [6].

Ontology for the e-Learning processes can be set up in various ways, but ontology will include a dictionary with explanation of the terms, and indications how the terms are related to another. This approach will give a valid tool for the learning process [7]. The role of ontology’s in e-learning is often underestimated; they can be useful for e-Learning systems [8].
The structure of the paper is given in the following way: The first chapter elaborates the background and related work. The second chapter discusses the challenges and goals of this research. The third chapter describes the methodology followed to conduct this research. The fourth chapter is the foremost argument chapter and discusses the role of Semantic in E-learning and why Ontology is important, survey result, and critical issues faced by practicing in academia. The fifth chapter describes the Semantic based E-learning management system especially for Pakistan environment. In chapter Six, the Semantic based applications practiced in academia, and some critical issues in academia while practicing these applications results are given on the basis of literature review and the conducted survey. Chapter seven concludes the paper and contains suggested future work.
CHAPTER 1: BACKGROUND

1.1 E-learning

Electronic base training is known as E-learning. A learner learns the instructional contents through the electronic technology. E-learning has a wide range of learning strategies and technologies; from CD-ROMS, videoconferencing, TV lectures, and virtual educational work, corporate universities and many more but our main focus is on virtual education, based on semantic web. E-learning has the potential of higher quality of education, more competitive workforce, increases the level of literacy and also is beneficial to reduce the costs of education training in institutions [9]. E-learning has different benefits over traditional classroom study: it is much faster, less expensive, create more interest to busy in study, get required information any time any place, keeps update easily, easy to manage large groups of students and many more [10]. There are also some disadvantages of E-learning as you feel loneliness and also it is boring text based courses.

1.1.1 Level of E-learning

There are four levels of E-learning, from the very basic to advance level. These levels are:

1.1.1.1 Knowledge database

It is most basic level of E-learning probably we have seen in software sites offering indexed explanation and guidance for software questions also gives the step by step instructions to perform specific task. We can find out the database by typing a keyword or phrase [10].

1.1.1.2 Online support

Online support is the second level of E-learning. Function of online support is almost similar to knowledge database. It comes in the form of online bulletin boards, chat rooms, email, or live instant – messaging supports. Mostly targeted questions are asked in it which has the more immediate answers [10].

1.1.1.3 Asynchronous training

Third level of E-learning is asynchronous training. Self learning is essential in this level; either it is CD ROM based, network based, internet based or intranet based. It is known as most traditional way of E-learning. You may contact instructor through online discussion board and email or it may be totally self study with links to reference materials in place of live instructor [10].

1.1.1.4 Synchronous training

Most advance level of E-learning, live instructor is available for everyone to negotiate their problems in a predefine time. Everyone can communicate with each other. This type of training takes place through internet web sites, audio or video conferences, internet telephone [10].
1.2 World Wide Web

Current web www has over than 11 billion pages and majority of them are only human readable format e.g. HTML [11, 12]. Tim Berners-Lee developed the WWW, defined it as "distributed heterogeneous collaborative multimedia information system". WWW is primarily document for centric communication services which focuses on the need of users using browsers [13]. The basic and powerful characteristics of WWW are [12, 13]:

- Revolutionizing the way people access the information. Current web pages act as a digital library for documents and are interconnected through hypermedia link.
- It opens new ways and opportunities in different area such as scientific information, virtual learning, commerce, health care, business.
- It is an attractive platform for multimedia and news. WWW provides news, sports and entertainment programs from all over the world.
- WWW has the ability to put together all type of media objects (videos, audio, text, images etc.) into a single document.
- WWW is a platform for businesses like Amazon, eBay, Stock market, Forex etc.
- This platform support almost all type of protocol i.e. FTP, E-MAIL, and TELNET etc.

Now doubt WWW has been changing our world by providing unbelievable features and benefits. However these web technologies have some limitations to support today’s dynamic, fast and robust computational requirements [13]. New web technologies are required to improve the current search mechanism. Following are the major problems in web technologies which enforce us to bring a new version and infrastructure for the web [13, 14]:

- Some time we do not get the result of our specify keywords. Although the required information is available in search document but this document use different terminology and vocabulary.
- Many times we get the information from a single web page and a single document, and it is extremely difficult to collectively get the information which is spread over several web pages and documents.
- Most information is HTML based format which is suitable for human but not suitable for machine. Many parts of the information are not well structured.
- Usually we get an excessive amount of information which is irrelevant to our required information. It is very difficult to separate so it is time consuming task.

1.3 Knowledge representation in Semantic web

“The Semantic Web is not a separate Web but an extension of the current one, in which information is given well-defined meaning, better enabling computers and people to work in cooperation.”

Tim Berners-Lee, inventor of the World Wide Web

Our current web is machine readable, while it is not machine understandable. The semantic web is a vision to solve this problem. Semantic web is an evolving extension of web, in semantic web information is machine understandable, precise, and ready for software agent to process, reuse and share it to describe the meaning of data [15]. Machine understandable indicate the machines ability to solve the problem by applying operation on data. The essential component of the semantic web is eXtensible Mark-up language (XML), XML scheme, Resource Description Framework (RDF), RDF
scheme, Web Ontology language (OWL). Burners Lee’s Semantic Web Architecture and its description are given below:

![Berners Lee’s Semantic Web Architecture](image)

**Figure 1: Berners Lee’s Semantic Web Architecture [15]**

### 1.3.1 URI and Unicode

Uniform resource identifier (URI) is the main component of the basic layer and it is used to identify a resource e.g. web page, country etc. URL and URN are the subset of URI. Uniform Resource Locator (URL) identifies resources through the representation of primary access mechanism. Universal resource name (URN) has to be globally unique. Unicode provides an international standard to encode the text. XML, Java and some operating systems have used Unicode as a fundamental scheme to represent text [16].

### 1.3.2 XML

XML document consists of three parts: XML declaration, a DTD scheme, and an XML instance. XML declaration and DTD schema are not compulsory for an XML document. XML declaration declares the version and encoding of XML being used. A DTD and XML schema specify the structure of XML document. An XML instance is a tagged document which shows the hierarchy and boundaries of elements of which are either delimited by start tag and end tag or by empty element by empty tag. XML document is known as well-formed if it follows the tagging rules given in XML [15]. An example of XML instance is given below
1.3.3 RDF

Thus we need some mechanism to express the meaning of XML tags so these meanings are expressed by RDF. RDF and RDF schema have already standardized by World Wide Web Consortium [17]. RDF is a model to represent data about data and it consist on a set of triples (O, A, V) that may be used to explain any possible relationship between the data object, Attributes, and Value [15]. RDF model does not give any explanation about the semantic of any applications domain; it just provides a domain-neutral mechanism to describe Meta data. It also not declare any mechanism to define the property names that are to be used.

RDF is layer independent of XML, the RDF model must be used, even if current XML syntax is changed or disappears [17]. RDF statement describes the properties of resource, and resource is an object that can be pointed by a URI. In RDF URI look normal while URL often used to point a specific part of a document. RDF schema allows us to describe the vocabulary terms and relation between them, which was not possible in RDF. Actually RDF schema gives the extra meaning of the RDF resources and predicates. This extra meaning tells us that how these resources should be treated [14].

<table>
<thead>
<tr>
<th>OBJECT</th>
<th>ATTRIBUTE</th>
<th>VALUE</th>
</tr>
</thead>
<tbody>
<tr>
<td><a href="http://qu.edu.qa/">http://qu.edu.qa/</a> #anonymous_resource1 #anonymous_resource1</td>
<td>created byname Phone</td>
<td>#anonymous_resource1 &quot;QU Web dev.&quot; &quot;4851238&quot;</td>
</tr>
<tr>
<td></td>
<td></td>
<td>rdfs:Class rdf:ID=&quot;book&quot;&gt; &lt;rdfs:subClassOf rdf:resource=&quot;#publication&quot;/&gt; <a href="">rdfs:subClassOf</a>... &lt;/rdfs:subClassOf&gt; &lt;/rdfs:Class&gt;</td>
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A SIMPLE RDF MODEL

RDF SCHEMA CODE
1.3.4 ONTOLOGY

In learning process ontology is a network in which learning objects are semantically related to logical domain. In philosophy ontology is the study of nature, of what type of thing exist, study of such theory is ontology. Every field defines the terms ontology in their own context, e.g. ARTIFICIAL INTELLIGENCE and COMPUTER SCIENCE defines the Ontology as: document or files define the relation among their terms. Most common form of Ontology for web is taxonomy, provides a set of concepts related with specialization relationship [5].
CHAPTER 2: PROBLEM DEFINITION/GOALS

Semantic web is going to change the way we use web, design and develop the web technologies today. Many technologies have been developed for constructing and developing the semantic web. During the last few years semantic web has achieved long milestones and also during this period it brought up new ideas to set up a new form of web. In this thesis first I try to analyze the visual semantic web development in detail and study the reasons that caused to come out the concept of semantic web vision. I will discuss the impact of this visual semantic web development on current research in academic and business environment. Also the aim is to study the milestones that visual semantic web has covered and the challenges it is facing in its progress.

Second main objective of our thesis is to present an e-learning management system for Pakistani environment with Meta data that provide a general platform for the Pakistani learning institutions. At the end I will test the proposed e-learning management system.

2.1 Aims and Objectives

Followings objectives are set to achieve the aims.

- To identify the main reasons that brought up the visual semantic web development
- To identify the problems for individual and a learner to adopt the visual semantic web
- To propose a ontology based e-learning management system with its Meta data
- To test the proposed e-learning management system based search application by applying Ontology Test Model

2.2 Research Questions

Followings research question will be answered during the thesis:

Q1. What is the main reasons that brought up the visual semantic web development?

The main intent of this research question is to investigate the current state of the visual semantic web conducted by literature review. This would help to understand the vision of semantic web as well as make a sound background of the study.

Q2. What is the basic problems for individual learner and organization to take up the visual semantic web development?

In the context of this thesis, the main focus of this question is to find out the limitations of semantic web, such as like no other better performance, class of services, scalability issues of ontology, RDF and XML, thoroughly would be discussed with the help of literature review. In this question I will compare both the schema of RDF and XML.
Q3. What is the ontology based e-learning management system for Pakistani learning environment?

That is the main research question for this thesis which will be answered by presenting an e-learning management system for Pakistani culture. Basically it is ontology based e-learning system for Pakistani culture (O-BEMS). We hope this system will attract the student towards learning materials and they will get clear guidance for their study, and especially towards distance learning.

Q4. Testing of ontology based e-learning management system (O-BEMS).

After implementation of (O-BESP) researcher will test the Ontology based e-learning management system. This is very important part of this thesis, which will be answered by passing the proposed system through Test Ontology Model.

2.3 Goal

The goal of our research is to design an e-learning management system that provide as a general pattern for Pakistani learner. This system consists on ontology for different process in e-learning, such as learning activities, learning style, teaching methods, and course syllabus. Following objectives are set to achieve the goal.

- Literature study to explore the topics of Semantic web, Ontology.
- Identification of the problems related to semantic web development.
- Advantages of the Semantic web over our world wide web.
- Design and conduct the experiment.
- Analyze the experiment result.

The purpose of the study is to gather academia and industry requirements for the implementation of e-learning management system (O-BEMS) from different perspectives. What kind of e-Learning environment will suite them? How can they save their time by efficient and relevant search results? Researchers focused on training material, related to search results in industry and online courses searching material in academia. However, after implementation, researchers will verify its results in academia and industry.
Figure 2: Research Plan
CHAPTER 3: METHODOLOGY

3.1 The Literature Review

Research methodology defines the research activities, how it process, how to measure the progress of research activities by adopting this or that methodology, which can lead to achieve the author objectives [17]. There are different approaches to conduct a research. According to Croswell Qualitative research, Quantitative research, and mixed research methods are the most popular methods of this methodology which are discussed below.

3.1.1 Quantitative approach

In Quantitative research researcher tests the proposed theory and hypothesis also identify the statistical relationship when analysis the data [18]. A Quantitative method involves survey design, mathematical modeling, and experiments. A survey design provides the numeric or quantitative descriptions of the theory or hypothesis. In experiments try to find out the impact of treatment on the outcome of the system. Data is variable type in it and it is concern with numbers or measurements [18].

3.1.2 Qualitative approach

Qualitative research is the one in which researcher gains the knowledge on the constructive or participatory perspectives or on both [18]. Phenomenology, ethnography, case study research, ground theory, and historical research are the five major type of Qualitative research. Each type has some special characteristics. Qualitative studies are tools used in understanding and describing the world of human experience. Qualitative studies aim to understand the social world from the viewpoint of respondent, through detailed descriptions of their symbolic and cognitive actions, and through the richness of meaning associated with observable behavior [19].

3.1.3 Mixed method

“Mixed method research in which the researcher uses qualitative research paradigm for one phase and the quantitative research paradigm for a different phase of the study”. [19, 18] Mixed method is combination of quantitative and qualitative methods. Mixed research uses both deductive and inductive methods, obtains both quantitative and qualitative data, attempts to corroborate and complement findings, and takes a balanced approach to research. It tries to mix the best of qualitative and quantitative research into research design. Mixed research takes a diverse, practical, and rational approach, suggesting that the researcher mix quantitative and qualitative in a way that works best for the given research question.

A mixed research methodology was used to achieve my goals and objectives. I have conducted both qualitative and quantitative studies. The goal is to acquire the needs of individual academia. How they can achieve more relevant results? How they can save time by efficient and relevant results? How they can improve their e-learning process? Case study investigates diverse aspect on e-Learning environment/framework, specifically universities and e-Learners. Further, in the last section of the report, experiment will conducted in order to verify the results of proposed ontology-based e-Learning management system for Pakistan culture. Experiment will be conducted in academia.

We divided our study into two parts; the first one is the literature review and the second one is base on experiment. In first part we have studied the literature about our research questions. The second part is an experiment and academia survey, this part consist of two phase in first phase there will be a training session, in which researchers will elaborate, how to use the (O-BEMS) ontology based e-Learning
search application. In next Phase, actual experiment will be conducted with the same group of users from academia.

I consulted the literature to highlight the research work by the experts, to extract and summarize the latest research on semantic web and e-learning development, and to support my findings. Research plan shows the flow of our work, and how I managed our methodology. Figure 2 shows the process of achieving the results. First I have identified the problem, and done some study to understand the domain knowledge and also set our scope. Then I planned our whole work along with the time. The next step was to select a methodology to conduct the research.

I have selected a mixed methodology for achievement of our goals. First part was literature review, in which I read that what literature says about our area of research. The other part is an experiment, which consists of two phases in first phase there will be a training session, in which researchers will elaborate, how to use the (O-BEMS) ontology based e-Learning search application. In next Phase, actual experiment will be conducted with the same group of users from industry and get the feedback about E-learning. During my search I used different keywords to find the best appropriate resource for information. I collected material from literature on “ontology based e-learning model” considering the following factors:

- The quality of articles
- Information resources
- Careful extraction of data for refining information gathered
- Analysis and synthesis of data with care
- Carefully suggesting recommendations for future work

3.2 Experiment objective

The basic purpose of this experiment in academia is to verify the results of developed search application, which is based on proposed O-BEMS. This experiment will verify that either the search application is efficient or not? How much the results are relevant to their queries?
Chapter 4: visual semantic web development, and its limitations

According to Berners-Lee the Semantic Web is “a web of data that can be processed directly and indirectly by machines.”

4.1 Visual Semantic web development, what it is?

The visual of the Semantic Web is a "network" that takes the apparently infinite amount of data on the World Wide Web, but also connects this information with data in relational databases and other non-compatible archives, for example, the EDI system. Given that relational databases house most of the data from the company, the capability of the semantic Web technology to access and process, along with other data from websites, databases, XML documents, and other systems increases the amount of useful Data exponentially [20]. Moreover relational databases already contain a large amount of semantic information. Databases are organized in tables and columns on the basis of relations between the tasks at home, and these relationships show the meaning (semantics) of data.

Applications for data integration offer the possibility for the connection of different sources, which requires a distribution of posts between the different databases. Semantic Web, however, can be a machine to connect to another machine and the exchange of data and process effectively on the basis of built-in, available semantic information describing each of the resources [20]. The fact is that the Semantic Web will make it possible for us to have all the information mentioned as a large database.

The Semantic Web data itself becomes part of the web and can be processed, regardless of application, platform, or domain. This is in contrast to the World Wide Web as we know it today, which contains virtually unlimited information in written form. We can use computers to search these documents, but have not yet read and interpreted by the people before any useful information can be transmitted. Computers [20] can transmit information, but cannot understand what information is useful to view the information that is most relevant in a given circumstance. Semantic Web, on the other hand, is to have access to information and documents on the Web so that machines can process, transform, assemble and even act on the data in usable form.

The Semantic Web is not a separate web, but an extension of the current, in which information is given well-defined meaning, better enabling computers and people to cooperate. The initial step in weaving the Semantic Web in the structure of the existing network has already begun. In the near future, these developments are important new step for functions such as machines become much better able to process and understand there are limited data to be displayed at the moment [21, 22].

Now I try to explain the semantic web vision with an example. Imagine this scenario. You are a software consultant and have just received a new proposal. You create a series of SOAP-based Web services for one of its largest customers. First, you have to learn a little about SOAP, so that the search for expression through your favorite search engine. Unfortunately, the results are presented with only is useful. There are lists of dish detergent, soap facials, and even soap mixed results. Only after sifting through more ads and read through the pages that have the ability to find information on the W3C specifications SOAP. Because of the different semantic associations of the word "soap", the results you get are different in weight, and you still have to do a lot of work to find the information you're looking for. But in a Semantic Web-based environment, you can use an agent for the Semantic Web to search the Web for "SOAP", where SOAP is a type of technology used in the specification of Web services. This time, the results of your search will be relevant.
His agent of the Semantic Web can also search the corporate network for specification of SOAP and discover where their colleagues have carried out similar projects or have published SOAP-related research online. Available research result is based on the semantic information available to SOAP; his agent also has a list of related technologies.

Now you know WSDL, XML, and URI is related technologies, SOAP, and you have to do some research on them, too, before you start your project. With regard to the above example, a list of scenarios that could benefit from the technology of the Semantic Web, as they continue to develop is only limited by your imagination. Think of the possibilities for everything from literary, criminal investigations, research, and analysis to shop, find long lost friends, and planning for the holidays. When computers can find data and this act on data is in a meaningful way. Semantic Web agent does not include artificial intelligence [21, 22] while it is based on structured sets of information and inference rules that make it possible to understand the relationship between different data sources. The group has not really understand the information the way a person can, but it has enough information to make logical connections and decisions. The full vision of the Semantic Web has not yet been fully achieved, but it has significant progress in the development and use of standards, languages, technology and applications.

4.2 Visual Semantic web development, where we are?

In recent years our society has seen a continuous, sustainable growth in the use of Semantic Web inventive in large and small organizations of many kinds. Much work has made to attain the vision of a machine that could read the World Wide Web, the Semantic Web. Many researchers and practitioners have already begun to think that a new web, on the basis of ongoing research and development. Some industries, and its main players are coming from a wait and see attitude (Cardoso, Miller et al. 2005) to the real world expansion applications that will give them added value and competitive advantage. To see how Semantic Web is in reality, you need only look at companies like Oracle, Vodafone, Amazon.com, Adobe, Yahoo and Google. All these organizations are working for an intelligent Web and certain provisions are already available on the Web. For example, Oracle has introduced the industry's first RDF (Decker, Melnik et al., 2000) management platform, orientation application areas such as life sciences (Stephens, Morales et al. 2006), data and content integration; integration of business applications, and integration of the supply chain. Oracle is already working with the expansion of the platform to support Owl. Vodafone, a major mobile phone, has been used RDF to describe and search for ringtones, games and pictures on its website. As a result of the page for emissions have decreased by 50% and revenues have increased by 20% [24].

Although the semantic Web is visualization yet as we discussed above, but in recent years, this idea has covered a long distance. It has been grappling with many problems and has simultaneously have noted charming promises for the future. In the next part of this section, on the basis of the arguments put forward by Jerome Euzenat in [23], and Arshad in [25], I have Describe current position of the Semantic Web in research, education and industry.

4.2.1 Research position in semantic web

- W3C have standards for XML, RDF, OWL and active working groups for these and semantic web services e.g. SPARQL and SWRL
- Ontology alignment system and framework
- Ontology alignment API’s
- Editor of the development of ontology, alignment and querying
- Regular lectures and workshops with participants from more different nationalities and geographical location
4.2.2 Academic achievement in semantic web

- Virtual institution for semantic web education content curriculum and events organized in a well manner and delivered in the semantic web infrastructure
- Dedicated curriculum for master program and PhD studies
- Annual Summer schools with increasing participation
- Active research teams in the world's best universities

4.2.3 Business standing in semantic web

- Oracle introduced the industry's first RDF management system, oracle 10.2 provides the facility to upload the RDF
- Adobe, Google, yahoo all these are organization are using intelligent web
- Jena API of HP, With HP investing more in semantic computing

4.3 Basis technologies in semantic web

There is lot of technologies available to create semantics on the web. Some of these core technologies are briefly discuss in order to that reader can easily understand the whole mechanism.

4.3.1 Unified modeling language (UML)

UML provides a collection of models and graphs to describe the structural and behavioral semantics of any complex information system. Some of the models provided are [26]:

- Use case model and scenario’s are use to collect the user requirement and functionality of the system. Scenario is the instance of use case.
- Class and object diagrams are use to specify the semantic structure of the system. Object diagrams are the instance of class diagrams.
- Activity diagrams to specify workflows.
- Interactions diagrams define that how group of object work together in some behaviour.
- State diagrams define the dynamic behaviour of an object in system.
- Physical diagrams define the implementation structure of the system.

4.3.2 XML and XML Schema’s

These are the tools used to go beyond the fixed-oriented structure of the HTML page that provides vocabulary. With XML, it is possible to describe the structure of data and documents under a personal or Community defined vocabulary. These vocabularies can be a kind of semantics and support for an open exchange of data within communities and the tools to understand the vocabulary.
4.3.3 RDF and RDF Schema

RDF is based on existing XML and URI (Uniform Resource Identifier) technology, a URI to identify all the resources, and the use of URI to make statements about resources. RDF [21, 26] statements are often called triple, which consists of a subject, predicate and object. It does not structure the syntax of the data, but defines semantic meaning for data on the web. Multiple semantic perspectives of the same data are possible. The technology is based on lower level technologies: URI's to identify web resources and Namespaces to identify different vocabularies.

RDFS used to create the vocabulary that describes groups of RDF-related resources and the relationship between these resources. An RDF vocabulary permitted defines properties that can be allocated to the RDF resources within a given domain. You can also create RDFS types of resources that share common characteristics. In figure 3 “triples” are shown for RDF statement which has the subject, predicate and object. After defining the “triples” as graphically we can code it either in RDF or XML.

![Figure 3: RDF Triples](image)

4.3.4 Topic Maps

Topic maps are a form of semantic web technology (in the broadest sense) and some work on interoperability between the W3C RDF / OWL / SPARQL family of standards for the Semantic Web. Topic maps define arbitrarily complex semantic knowledge structures and allow the exchange of information needed to build common and maintaining the index of knowledge. They provide a more comprehensive approach to RDF, in principle, because they are not limited to use on the Web.
4.3.5 Web ontology language (OWL)

Ontology language gives greater machine interpretability of Web content to support for XML, RDF, and RDF Schema. They do this by providing additional vocabulary along with formal semantics. OWL is possible to implement a semantic description of a specific domain, indicating the concepts and relationships between concepts. There are three particular sublanguages: OWL Lite, OWL DL and OWL Full. We can define "ontology" in connection with the Semantic Web [21.] as a system that formally defined hierarchies and relations between different resources. Semantic Web ontology is taxonomy and a set of rules for the inference that the machines can make logical conclusions.

Taxonomy, in this context is the system of classification, groups of resources into classes and sub-classes based on their relationship and common property. Since the taxonomy to express the hierarchical relationships between resources, we can use OWL to assign characteristics of classes of resources and allow their sub-classes that inherit the same characteristics.

4.3.6 Software agent

One of the fundamental technologies that can utilize the code of semantics on the Web is a software agent. The definition of a software agent is rather unclear, but most researchers in the field refer to the concept that a program can take action, is adaptive and partially independent and can communicate with other players and their creative human being. Here we will use the term software agents to enter all the computer programs that can read and process the code semantics of data to help people perform their tasks more efficiently and effectively. Agents can even accomplish the reasoning capacity again when he discover new ontology. Semantics also makes it easy for user to take benefit of a service that partially coincides with a petition.

4.4 Problems and needs in semantic web

The above section presents the visual and achievements of Semantic Web development. It has been succeeded in its path to become a reality, and offers bright prospects in research, education and industrial areas for Semantic Web. This section presents ideas and thoughts to describe the barriers and problems in the way of visual Semantic Web development.

4.4.1 Is it acceptable?

In the previous chapter we have discussed that Semantic Web has been changed the way we used to design, develop and deploy technologies on the Web today. It is important to emphasize that it is not just about changing on the other hand there are some arguments [27] that it is the Semantic Web who will break the Internet model entirely. It requires too high degree of precision and trying to wrest control from the user and place in the hands of the Model Maker [27]. And the change is twofold: how information is represented on the Web and how it is download and process on the Web. The main problem is that are we truly ready to admit this change?

4.4.2 How to make sure privacy?

How many of us are willing to disclose to its semantic representation of knowledge system as large as the WWW? There are not many off course? And the issue becomes more severe in the case of organizations that not only individuals. The idea to write down each and all on-line resources requires people and organizations to expose their semantics it will mean more challenges for the visual Semantic Web development to ensure that adaptability for individuals, businesses and industry.
4.4.3 How to build confidence?

In the visual semantic web development we assume that the one based taxonomy in the first place know and can define to everyone's satisfaction, which means that taxonomy. But this is not how it works in the real world [29]. Almost every person in the world has different comments and views on other people thoughts and ideas. A man who is hero in particular society but it could be a traitor for another society or group of peoples, and it is unlikely that explanation shaped by a person is acceptable in general means for everyone. The reliability of the suggestion of Semantic Web is doubtful [27, 31].

Although there are some fundamental building blocks that are in the visual Semantic Web development to ensure both the privacy and trust [8], but most of the requirements that these issues are missing is about the future of the W3C Semantic Web [32].

4.4.4 Taxonomy of the taxonomy

Taxonomy is the basic building blocks for the representation of knowledge on Semantic Web. Before that can come close to a visual Semantic Web development to become reality; we must have a taxonomy of taxonomy to define the form of taxonomy of work and their common terms mean and how to develop, define and disseminate their small issue [27]. And then there is a need for another goal as taxonomy for Meta taxonomy also [27]. All this makes it a real problem situation and needs to be addressed carefully.

4.4.5 What about layers structure?

The layers are the languages and have the syntax. The syntax of a layer can be an extension of the previous layer, for example, RDF syntax is part of the syntax of XML, RDF uses XML as syntax, but it is not correct that all XML documents are valid for RDF documents. Similarly OWL would have the same syntax as RDF and its semantics would be an extension of the semantics of RDF (S). This overlap is the relationship you can expect to be used by designers of RDF(S). As we have read it through different statements on the RDF(S), so it clearly shows that we are extending the relationship from RDF to OWL, which leads it to the semantic web paradoxes. Since this stratification of OWL on top of RDF(S) shows that layering structure is an ambiguous.

4.4.6 What about alignment?

Although there are many well-organized and serious efforts [28] on the ground, leading to a fair system, frameworks and tools but ontology Adaptation is still a fundamental challenge for the semantic Web today. Main portion of the problem is very crucial and is linked to social, cultural and scientific diversity in the computer world.

4.4.7 Effect on different scenarios

Semantic Web technology [31] and specially ontology are not always practicable in all sorts of settings and mechanisms. On some places like Political, Spiritual and Societal issues where ontology does not work every time. People passes different views on these issues and do not like to give an argument every time on these issues. Therefore, we must go back and look at these other methods or types for these kinds of circumstances.
4.4.8 Who will take step?

The main strength of the Semantic Web is to recognize and support all kind of possessions, not just html pages on the web noted carefully. The question arises that who will take initiative to prove this Comment? Another thing is that there are reasons behind it? Are webmasters just starting typing all the current web pages? Professor James Handler, a well known personality in the Semantic Web research [30] recognizes this as a hydra of double chicken-and-egg problem. They argue that Web users do not label their pages if they do not see the value in do, and tools to show that this will not be developed on the Internet labeling.

4.4.9 What is its future?

Visual Semantic Web development posses on its enormous success and has shown significant growth in different directions, from research to industry and institutions to business. As well as on the other hand, challenges are also enormous, especially these visual ideas about semantic web have to become a reality according to the Web level in the near future. We recognize Semantic Web technologies probably decisive role to play in the semantics of intranet enterprise level in the near future.

It is easier for institutions to keep their system best in a more robust, free and formal way. Service-oriented architectures a semantic field that show a great potential for learning and business processes. The main Objective of the self awareness through e-learning is to get the knowledge without explanation and formal description. It is very central to the growing complexity and distributed nature of today's learning societies. Semantic web services and information technology have the potential to meet these requirements.
Chapter 5: Visual semantic web development, Ontology Based e-Learning management system

E-learning courses must serve very different student groups and also appears in many different ways. E-learning organizations are quickly accepting numerous new Web technologies. In student groups, some groups are for beginners, some for intermediate and some for advanced level students with experience. Moreover, e-learning courses can attract the attention of dependence or independence of the students either who are studying full time or part time. On the other hand e-learning based on certain conditions, such as management, culture and information technology [33, 34].

The purpose of e-Learning Management System is to improve people's ability to proceed successfully towards the objective of the organization through better use of information resources in the organization and individuals. For this purpose, the ideal situation is the grouping and structuring of information in a central location, so that knowledge is easily available, in accordance with the current course of work.

5.1 Preliminary assessment of ontology

Ontology is the study a variety of entities and tries to find out that what kind of units and things are in the world. In this research our work on the ontology defines the set of conditions and concepts that say something about the each of the cases (units). The intensity [35] of description of ontology is a hierarchical taxonomy related to the conditions and restricted or defined vocabulary with the help of semantic networks.

Ontology for e-learning processes can be created in many ways and ontology has a glossary with explanations of conditions, and information about how words are related to each other. This strategy will provide a valuable mechanism for learning while ontology represents conceptual descriptions of content that will identify the factors and interaction in a particular field of knowledge [36]. It is ontology transformed into theories of content, to help classify the types of objects that are in a particular domain of knowledge.

5.2 Semantic web in e-learning management system

A new web generation, the Semantic web have a promising technique for improving the semantics Interoperability for e-learning components. Most of the Semantic web domain ontology is to receive a formal conceptualization of a single domain. The new-generation web, the Semantic web has the best capabilities for composition and reuse of materials and contexts of e-learning. The Semantic web provides an opportunity to improve the metadata connected with e-learning materials and also expansion of the existing opportunities for e-learning stipulations.

The e-learning sphere of influence promising some new rules which would describe the learning resources, including learning objects metadata. LOM (learning object metadata) is regularly [37] fetching the standard for the management of education systems and learning objects of various kinds. So the teaching materials for students from Pakistan must deal with a specific theme in various ways such as video training and learning games. By this Pakistani students tend to attract a starting material for learning and can get a clear direction for their courses, particularly in distance learning studies. The largest and main part of the Semantic Web in e-learning is a field of ontology, which should give a proper explanation of a concept of shared domain.
5.3 Architecture of O-BEMS

This part of the research presents the requirements and design of O-BEMS. Details of the structures of reusable e-learning processes and for that purpose we require a standard metadata. The rules must fulfill the requirements of the application. These rules also selected according to the extent and the environment. Various organizations have developed their own vocabulary for metadata standard according to their particular requirements. Not all such standards are compatible. The common understanding between different metadata vocabularies is not good which leads it to the use of ontology as a conceptualization of e-learning structure. Figure 4 shows an overview of the fundamental components of the system and their relations which described in the following

![Architecture of E-Learning Management System](image)

Figure 4: Architecture of E-Learning Management System [33]
5.3.1 Description of lessons

The explanation of the lessons presents the structure of each chapter in more specific way. Description of the lessons display and meet all the objectives of the course. With the aspect of semantic, appropriate language must be used for example syntax and presentation of the contents must be considered. On the other hand it describes that the lesson can be up to the level of knowledge of each contributor properly.

5.3.2 Teaching and learning style

A proper method has to be designed for teaching and learning system. Present the material in such a way that learners must be a good interaction with their instructor as well. Different user requirements must be met on your own. Students must be able to control the level of the process and its lessons. Another motive is a source of information means feedback that students can give each step in the learning process. The whole system provides opportunities students to identify and endorse reflection and analysis of processes. Students get help to solve problem at any stage of the e-learning process.

5.3.3 Design interface

User interface for e-learning system must be attractive and also content must be placed in the appropriate place for Pakistani student. Which encourage the student to take participate in learning activities with more attention. Texts are listed in both English and in Urdu. All links on website must be work no dead links is tolerable. A good font with the right size, pleasant colors and buttons, graphics, photographs are important for students to continue with its content.

5.4 Ontology based E-learning Management system’s framework

Based on the gathered information through our qualitative research methodology, it can be seen that the main challenge of e-Learning systems are efficiency and relevancy of the results. To meet these challenges, this section presents “Ontology-based e-Learning management system’s Framework (O-BEMS)” shown in Figure 5. It has been developed using web services, an ontology and agent components. In the following subsections, based on the semantic web technology and e-learning standards we describe our proposed e-learning model, illustrated in Figure 5

The heart of the O-BEMP is present in Figure 5, an architecture overview of our approach that focuses on the definition of abstract services, web services instances, LOM, XML, SCROM, RDF, OWL and the user’s expected goals. While developing protocols within such architecture, promotes interoperability there is a chance that these protocols will not always be understood. O-BEMS defines three main layers interface, service integration and management. The aim of the framework is to provide an integration service platform that offers learner-centric support for web-based learning, which will improve the efficiency of the e-Learning applications and as well the relevancy of the search results. O-BEMS has proposed using web services, an ontology and agent components.
Figure 5: Proposed ontology based e-learning management system’s framework

The e-learning management system using learner or instructor system, designed as a web-based data transmission system. In learning system a learner has to perform different functions when he tries to access the system. First of all a learner need to log in the system if he is already a member of the system otherwise he need to register in the system to fill the information about him so that he can access the system next time. A learner has to select the subject and chapter of that subject. Take the quiz and get marks on it. Log out the system if the learner wants to exit the system.

The instructor side uploads the information such as to add the new subjects, chapters, quizzes and exams. Admin side keep the student record in his database also can edit the data if it required. After the permission of admin a learner can add subject, chapter, exams, quizzes, and log out from the system.
5.5 Metadata for E-learning management system

Here is an overview of the metadata used to create e-learning system. The main points of the system are access the system, academic record, educational materials, learning assessment, communication between teachers and students, news updates and some other facilities such as help system for teachers and students if they face any kind of problem. Metadata for e-Learning Management System defines the handling process of management system for e-learning. Here we implement ontology on learning objects and management system. It creates a rich description of each object as well as to serve the Semantic Web. This strategy includes the selection, assembly, integration and evaluation of educational materials, and an assessment of needs, weaknesses and learning behaviors.

5.6 Ontology for metadata

E-learning management system has different data points. In Figure 6 shows the ontology of metadata with several points in the field of educational. The most general point is Educational Material. Educational Material has two subtypes: Course Material and Examination Material. Examination Material can be further specialized to Project Task, Exam Task, and Exam. The Exam can consist of the Exam Task-s. Course Material can be further specialized into Lecture, Example, Lecture Note, Course, Exercise, and Project Assignment. The metadata roles represent the planned usage of the data in general. When ontology for any metadata is structured it is already understood whether it will be a Lecture, Example and so on and it hardly fits to another function. In addition to the ontology roles, we identify metadata types as well. Metadata represent different context of a data. It means that we can distinguish at least between examination and study material. In Figure 6 are representing as separate ontology for Study Material and Examination Material.

![Figure 6: Ontology for Educational materials](image-url)
One of the important concepts of the ontology is the “Relation” concept. With it, we can connect learning Object with other in terms of versioning, belonging, requirements and other useful relationships. Ontology for learning object has been given in the following figure. Here, we use only an explicit part of a learning object and it’s depending on requirement, rather than to learn or use whole learning object in a specific e-learning system. To use this ontology to facilitate e-learning with a semantic construction, ontology, as it provides a clear definition of a common domain. Ontology [33] gives vocabulary to describe the conditions of a substance, as well as logical statements that describe what the case is, how the components and context may or may not be classified and related with each other.

The O-BEMP is best system with a structured learning environment that is transparent and accessible via the Web. The system allows us to reuse of materials and use of Semantic Web functions for the configuration and composition. In addition to presentation of knowledge in various subjects will be distributed to the appropriate actors. We implement an educational system that focuses on the special needs of regional students learning style as a group, association, visually oriented. The system contributes to development, learning and assessment of skills of the students.

Figure 7: Ontology for learning object
Chapter 6: Testing of ontology based Management System

6.1 Testing objective

“The process of operating a system or component under specified conditions, observing or recording the results, and making an evaluation of some aspect of the system or component”.

The term testing can refer to many different but related activities, main purpose behind that is to evaluate some property of ontology based e-learning management system, and eventually to increase our confidence in the precision of the product to our objectives. The test is conducted to assess certain aspects or property specified, and the aspect that sets the target for the test. Another implicit assumption of the above definition is that testing presupposes the execution of the system, and in this sense testing is usually referred to as a dynamic evaluation activity. As such it is distinguished from other complementary checks, based on static analysis techniques, which can be used to evaluate a system or component.

6.2 Conformal testing

A very important objective is to validate a system or program that really does what is expected of them. Testing in this case said Conformal testing, and the goal is to ensure that the product under test is constructed in accordance with the policies, procedures and standards [40]. In particular, we focus on standard specifications is the structure of the software (for example, using the identifier, number and types of arguments, etc.) or their behavior, that is interaction with the user and between different components.

6.3 Applicability to E-Learning

Given the e-Learning domain, the traditional methods of development, of course apply the testing strategies and should be considered in the development of e-learning environment. In terms of content they are not relevant, but can be quite interesting to discuss the implementation of the proposed criteria for the Web-testing of systems for the analysis and testing of content.

6.4 Example of Learning Ontology

The ontology of a service called Learning material Search is specified using OWL-S. The service takes inputs Course and Examination materials, and Education material. Figure 6 shows the Education definition. The Education material has two subclasses including Course and Examination. Course material has four subclasses Example, Lecture notes, Study materials and Lectures, Examination material has three subclasses. The Education material has a property which can have only three values: For Student, For Teacher and For Management. In addition, Education material has the following constraints:

- Material for Education is those with student or management i.e., Material for Education \equiv (Education \cap has Material (Student \cup Management)).
- Examination material is those with Exam Task and Exam i.e., Campground (Education material \cap has relation (Examination material)).
- Course material are those with Lectures notes and study materials, i.e., Course material (Educational material has \cap Relation (Course material)).
6.5 Test Ontology Model

A test model provides a definition and description of the test situation information such as the organizational structure of test suites, test definition, test plan, and programming. This model should be set independently of the platform and programming language in the subject to test and therefore can easily be preserved and reused. A typical test model is the UML (Unified Modeling Language) U2TP (UML 2.0 Test Profile) [41].

U2TP provides a language for modeling testing, including test architecture, behavior, data, and time. It uses the UML meta-modeling approach. A MOF (Meta Object Facility) meta-model is defined to enable the use of U2TP independent of UML [38]. This paper proposes an ontology-based test model TOM that is compatible to the U2TP. In addition, it enriches the semantics of the U2TP model with class properties and constraints using ontology information. Furthermore, it provides better supports for testing by enabling C&C checking to detect the test design faults of incompleteness, inconsistency, and duplication.

TOM indicates testing products from two perspectives: the design of the trial and execution. For the test design, where the key concepts of test cases and test suites from two aspects:
1) Test data specific information on concepts including data pool, data partitions data selection strategy and values for each of the Input / Output is defined in the service.
2) Behavioral tests preparation, testing procedures and expected results for each test to be conducted. Through a test of implementation, indicating the information to exercise designed test cases / suites. It also contains two parts:
   - Test, which indicates the organization, programming and configuration of distributed execution of test cases.
   - The results of the tests are the result of evidence collected for statistical analysis and quality evaluation.

Figure 8 shows the relationship between the concepts and elements of TOM modeling. As shown in the diagram, service about Subject under test is associated with a group of test cases. One set of data pools to test data, a set of tests for the scheduling of test report and a set of test results for each test execution. A test consists of two parts: the information and behavioral part. A group of data consists of data to test for a particular purpose. For example, a service can have three pools of all your data, including tests, tests of reliability, security and functional testing, respectively. The pool of a database divided into different parts of data that representing sub-domains. Data can be selected from different parts of data at run-time.

For example, taking the Learning Material Search example, the input parameter Education Material may have a data pool for functional testing, which can be partitioned into three categories by its ratings as Course material, Examination material and Management materials for Education material. Thus it may be useful for a regression testing “only re-test the search service for Management material”. The behavior part defines the actions and orders of actions for a test case. The actions maybe test preparation, event triggering, data input, and test cleanup.

The model allows the dynamic partnership between the measures and their associated data. A test that defines the scheduling of the test runs. Test cases can be arranged in test suites. The test plan defines the scheduling test series as a result and at the same time. It also defines the configuration of a test, such as the expansion of the test on a local network to distribute the test. The test plan allows dynamic new composition of the test and re-configuration of the test runs. TOM can support cooperation between all stakeholders, including teachers, intermediaries, students and other services of independent evaluators [38], and everyone can contribute and share in the assets of the evidence test, test data and results of tests early on the Web, where a user can be an active contributor.
An important issue for automated testing is the generation of input data. Partition settings have been used many testing methods, including the white box and black-box test [40]. Parameters such as grants or the environment can be divided into subgroups domains called partitions. Test data are selected from the partitions based hedge quantity strategies. The yield on the partition test depends largely on whether the selected partitions. But traditionally, most of the partitions created manually according to the tester's intuition and experience. Some automation is possible, but limited to syntax, such as data type of analysis of a specific programming language. SOA introduces standard service interface design and standard data definitions based on XML schema. Owl-S enables ontology-based semantic specification IOPE service. This semantic information can improve opportunities for machine understandable definition of data and automatic generation of data partitions.

6.5.2 Data Partition Relationship Analysis

OWL supports the following relationship definition among ontology classes:

- **Subclass**: It means that if X is a subclass of Y. In our system Course material is the subclass of Education material.
- **Equivalent class**: Two classes have precisely the same instances and can be replaced alternatively.
- **Disjoint class**: A member of one class cannot simultaneously be an instance of a disjoint class. It indicates that two partitions are non-overlapping e.g. Lectures is the member of Course material and it cannot be a part of Examination material.
- **Intersection class**: A complex class can be defined by the intersection of classes and/or property restrictions. It means the individuals of the class should satisfy all the classes and restrictions.
- **Complementary class**: It means that if X is a complementary class of Y, then X takes all the individuals that are not in Y.
6.5.3 Data Partition Property Restriction Analysis

Properties restrictions, includes the cardinality and value constraints. The cardinality constraints define the minimum and maximum number of values of a class property. For example, Education material can have exactly one value about an educational organization. The value constraints define the value scope and range of a property. Owl: all Value From requires that for every instance of the class that has instances of the specified property, the values of the property are all members of the class indicated by the owl: all Values From clause. For example, suppose that authentic student can only go for exam in the examination hall. Hence, that is Possible In property of exam ontology has the restriction of “only authentic student” indicates that allows him. Owl: has Value restriction allows us to specify classes based on the existence of particular property values. For example, suppose only 2 values are defined for authentic students, hence the system has authentic property of student has an owl: has Value constraint as an enumeration of the accepted values “{allow or not allow}”.

6.5.4 Data Value Generation

The data partitions defined the test classes. Test data instances are generated by filling the class properties with real values. The data values can be generated based on the constraint analysis of the property, especially the value constraint and cardinality constraint. One can also define rules for deriving data values. Rule language such as SWRL (Semantic Web Rule Language) can support the specification of the dependencies and restrictions of the input data. The following is an example of the companion relationship between two students but have different study program in proposed system. Two students x and y are considered companion if they have the same institution e.g. Suppose that a service requires two inputs parameters of two companion students. By reasoning the rule, the test generator can generate the pair of test inputs.

6.6 Ontology-Based C&C Checking

C & C is important to ensure that all the signs of goods and services ontologies are accurate and make sure that there is not any incompatible or contradictory definitions of assets may occur. C & C set standards for verifying the information received and the data partitions [38]. In general, the four categories of rules are distinct for the class, relationships, characteristics and limitations, respectively. C&C checking are performed from two perspectives:

1. The internal C&C checks the testing assets within the TOM. In it check the concepts which are classes in the sense of RDFS and for which set of instance are available in the source, also check the properties of concepts.
2. The external C&C checks the testing assets against the OWL-S specification, as well as categories which represent abstract property values used for semantic grouping of objects.

<table>
<thead>
<tr>
<th>1st Category</th>
<th>2nd Category</th>
<th>3rd Category</th>
</tr>
</thead>
<tbody>
<tr>
<td>Recognize class/individual!</td>
<td>What is class/individual?</td>
<td>What are the properties of class?</td>
</tr>
<tr>
<td>What kind of relation is between two classes/individuals?</td>
<td>Who is in relation with Class/individual?</td>
<td>What is value of individual’s property?</td>
</tr>
<tr>
<td>Does class has property?</td>
<td>What relation is between two Classes/individuals?</td>
<td>Who is and how in relation with Class/individual?</td>
</tr>
<tr>
<td>Are two classes/individuals in relation?</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Figure 9 Categories and questions for Ontology System
6.7 Tool Implementation and Experiments

Experiments are exercised on an OBMS composite service. Ontology is defined for a simplified learning domain and the OWL-S are specified for the process of Examination materials which is a composition of two search services including Course material and Examination material. Table 1 shows the partition and data value generated for testing. A prototype tool has been implemented as a RCP (rich client platform) application on the Eclipse platform, as shown in Figure 10. It incorporated with open source projects for OWL editing (Protégé), parsing (Jena2), interpreting (OWL-API) and reasoning (Pellet). The OWL-S analyzer imports and interprets the OWL-S specification of the SUT. IOPE information is collected for test generation.

<table>
<thead>
<tr>
<th>OWL-S Viewer</th>
<th>TOM Editor</th>
<th>C&amp;C Reporter</th>
<th>Rule Editor</th>
</tr>
</thead>
<tbody>
<tr>
<td>Protege</td>
<td>TOM Generator</td>
<td></td>
<td>C&amp;C Checker</td>
</tr>
<tr>
<td>OWL-S Analyzer</td>
<td>Test Ontology Model(TOM)</td>
<td>Jena2, OWL-API</td>
<td>Rule Engine (Jess)</td>
</tr>
</tbody>
</table>

Figure 10 Architecture of the Tool Implementation [42]

The TOM generator interprets and reasons over the service ontology definition, and generates the test cases according to the TOM. C&C checker validates the derived test cases based on the C&C rules defined offline. A rule engine, Jess, is also integrated to enable rule-based reasoning. The SWRL specified rules were translated into Jess inputs for interpretation. TOM editor’s user interface which recognizes the parameters and ontology classes defined in the service. It also shows the data pool and data partitions generated for Education material, and then details of a data partition, including the data values and properties.

The comparisons between partition testing and random testing have been discussed [42]. In general, partition testing with properly designed partition can achieve better performance than random testing can. This paper shows that the ontology-based approach can improve the adequacy of data partitions and improve the testing effectiveness.

6.8 Evaluation Process of Teacher’s View

Study materials, Lectures, Project assignment, Examination materials and Test or Quiz, as parts of courseware contents, we can create almost any combination of learning objects. In general, the first condition for Quizzing or testing, which teachers meet while the construction of the course, the presence of a field of knowledge. When teachers want to publish a Quiz, you must choose an aggregation of the training range of factors that will keep the new learning added to test the function. After the name of the object of learning, the system calculates the number of terms. For dynamic testing [39], add at least should have chosen a subject of learning to generate more questions for some subset of the knowledge domain, groups learning objects.

An algorithm for proposing number of possible question series will count these elements of the domain knowledge: C – the classes count, I – the individuals count, R – the relations count, P – the properties count, M – the media properties count.
6.9 Evaluation Process of Student’s view

Later when the student chooses test system initiates the process of dynamic testing of production and presentation. Dynamic quiz generation in the e-learning management system means runtime Creation of question text and answers over prepared set of the domain knowledge elements. If there is going to be generated question based on the second question template then algorithm is randomly choosing knowledge domain elements according to the placeholder’s requests for particular domain knowledge element. When a student starts the dynamic quiz, the initial level of difficulty of a problem is sent to the problem generator.

According to this level of difficulty, the system generates some questions and sends it to the student. The first pair consists of two questions from the second category. After resolving these two issues, the student submits their responses, to be assessed, thus giving partial test results. These results are used by system and has very important roll on. The problem generator, according to partial results of these reviews, decides from which difficulty category will be the next pair of questions distributed to the student or, in the worst case, violently interrupts testing and gives unsatisfying mark.

After the last question overall results are calculated on the basis of calculation of the final agreement on the relationship between points and achieve the highest possible score. Calculated mark varies from an unsatisfying to an excellent. Presenting the result of the test involves not only displaying final mark, but also it gives back set of correct answers as well as the question category sequence. Therefore, the student can actually see where she/he was wrong and afterwards choose concept or relation to see exactly where, how and why she/he had made a mistake [39].

6.10 Knowledge Evaluation

Student’s knowledge evaluation in the Ontology based e-learning management system is realized by quizzes. Quiz is a test of whether the student has a number of questions with answers that can be attached correctly or incorrectly. The teacher is responsible for ongoing testing. Dynamic tests, generated by the ontology-based e-Learning Management System, are often used to quickly assess students’ knowledge. This kind of quiz has questions structured on queries about concepts and relations.

Survey of Ontology based E-learning management system

6.11 Practitioners View about E-learning Management System

During our survey we imposed different questions to respondents regarding the implementation of e-learning management system development in academia. It is based on a Questionnaire Survey of People on the e-Learning management system. Respondents to the survey were from 6 different countries with Pakistan (50%), China (20%), India (10%), Bangladesh (10%), and Germany (10%). All these respondents are students and studying in BTH. The result of this survey summarizes information about the status of ontology based e-learning management system based on 20 responses to a questionnaire circulated in 2008 to people on the e-Learning management system. The majority of identifiable respondents to the survey were thus men, studying in universities.

These respondents gave a variety of information on their practices in e-learning, and it is difficult to generalize on the basis of global evidence. But respondents also noted that the biggest barrier to try to apply and developing e-learning and practice, including lack of infrastructure (including components, particularly in rural areas) and the need for adequate training and capacity development, lack of digital content, and the cost of implementation.
6.12 Infrastructure: the availability of IT facilities to students

I asked respondents that they had access to a computer, internet, and if so, what type of computer devices they had (tables 1). Table 2 sows the respondent response about internet facility. These figures are calculated as a percentage of total respondents, and this amount in the case of computers exceeds 100% because some students have access to more than one type of unit. If the sample is representative of that answer, then it seems that 91% of students have access to any form of personal computing.

Table 1. Computer devices to which students have Personal access.

<table>
<thead>
<tr>
<th>Type of computer access</th>
<th>Percent of total respondents</th>
</tr>
</thead>
<tbody>
<tr>
<td>Desktop PC</td>
<td>63%</td>
</tr>
<tr>
<td>Laptop PC</td>
<td>33%</td>
</tr>
<tr>
<td>Handheld computer</td>
<td>18%</td>
</tr>
<tr>
<td>Internet enabled mobile phone</td>
<td>21%</td>
</tr>
<tr>
<td>No PC at all</td>
<td>0%</td>
</tr>
</tbody>
</table>

Students have a home Internet connection, which covers 62% of the total number of respondents. Different types of connections available to students: telephone modems, 52%, broadband, 39% and a network connection, 9%. We ask students to estimate the average amount spent by a home Internet connection to access e-learning materials, compared with the campus facilities (Table 2). The results show a strong dependence of universities, with 60% of the students using the university network at least half of the time.

Table 2. Use of internet, ‘home’ relative to ‘University’ internets Connection for e-learning.

<table>
<thead>
<tr>
<th>Description of pattern that most closely described student’s access to e-learning materials</th>
<th>Respondent Response</th>
</tr>
</thead>
<tbody>
<tr>
<td>I almost always use my home connection</td>
<td>58%</td>
</tr>
<tr>
<td>I use my home connection about 2/3rds of the time and University facilities about 1/3rd of the time</td>
<td>23%</td>
</tr>
<tr>
<td>I use my home connection about half the time and University facilities about half of the time</td>
<td>28%</td>
</tr>
<tr>
<td>I use my home connection about 1/3rd of the time and University facilities about 2/3rds of the time</td>
<td>21%</td>
</tr>
<tr>
<td>I have no home connection, so nearly always use the University facilities</td>
<td>9%</td>
</tr>
<tr>
<td>I do have a home connection, but nearly always use the University facilities</td>
<td>12%</td>
</tr>
</tbody>
</table>
Types of courses addressed by Ontology based E-learning

On the issue of education levels which addressed by ontology-based e-learning courses, respondents indicated the following:

<table>
<thead>
<tr>
<th>Types of Courses</th>
<th>Respondent Response</th>
</tr>
</thead>
<tbody>
<tr>
<td>Higher education</td>
<td>63%</td>
</tr>
<tr>
<td>Continuing education</td>
<td>13%</td>
</tr>
<tr>
<td>Vocational</td>
<td>33%</td>
</tr>
<tr>
<td>Technical education</td>
<td>29%</td>
</tr>
<tr>
<td>Special educational needs</td>
<td>9%</td>
</tr>
</tbody>
</table>

This reinforces the view that among the professionals who answered the survey, most of the uses of the system are in higher education and vocational fields.

6.14 E-Learning Management Systems and practices

This was reinforced by respondents in their answers to questions about the techniques of e-learning and the methods used in teaching. Even though it is difficult to generalize from different points of view, the practice seems to be the dominant use of the Internet by 24% (6), e-mail by 15% (5), CD by 12% (4) Web 12% (4), video in a 9% (3), chat in a 9% (3) and presentations by 9% (3).

Discussion forums were mentioned by only 6% of the respondents (2); multimedia, 6% (2), use of digital libraries in a 3% (1), an offer of a 3% (1) and only 1 respondent mentioned the particular educational games. This indicates once again that there is a high degree of complexity in the use of e-learning among the majority of the respondents.

In another question, respondents were asked specifically if they are involved in the development of e-learning, and 44% (14) answered yes to most of the respondents therefore do not see themselves as being involved in the production of content for e-learning. Curiously, in a rights issue, even fewer respondents 30% (9) said that they will participate in the management of e-learning courses.

6.15 Students’ perception of the Ontology based E-learning

We asked the students whether they agreed or not with any statements on ontology-based e-learning as a learning tool. The answers are presented in Table 4, and were largely echoed by the focus groups. Table 4 shows that students’ opinion of the key positive aspects of Ontology based learning system appeared to be flexible in learning in the sense of place and time, the link to GroupWise, downloads of lecture notes, and as a source of information about the curricula and coursework. A high proportion of those who had used online evaluations and tests published on the Ontology based learning system felt that they represented a useful way to verify that they understood course material.
Table 4. Students’ opinions on aspects of ontology based E-learning as a learning tool.

<table>
<thead>
<tr>
<th>Statement</th>
<th>Percent of Respondent</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Agree</td>
</tr>
<tr>
<td>The ontology-based e-learning enables me to learn at a place and time of my choosing</td>
<td>80%</td>
</tr>
<tr>
<td>I sometimes have technical difficulties accessing the ontology-based e-learning</td>
<td>20%</td>
</tr>
<tr>
<td>The ontology-based e-learning facilitates group work</td>
<td>40%</td>
</tr>
<tr>
<td>Using the ontology-based e-learning has enhanced the knowledge and understanding I gain from lectures, tutorials and practical</td>
<td>70%</td>
</tr>
<tr>
<td>The ontology-based e-learning allows me to provide feedback to my lecturers and tutors</td>
<td>60%</td>
</tr>
<tr>
<td>The ontology-based e-learning provides useful links to other web-based learning resources</td>
<td>40%</td>
</tr>
<tr>
<td>The ontology-based e-learning provides a useful link to web-based email (GroupWise)</td>
<td>40%</td>
</tr>
<tr>
<td>Assessments and tests posted on the ontology-based e-learning are a useful way of checking that I understand course material</td>
<td>80%</td>
</tr>
<tr>
<td>I use the ontology-based e-learning to download or view PowerPoint presentations and notes connected with lectures</td>
<td>80%</td>
</tr>
<tr>
<td>The ontology-based e-learning is a useful one-stop resource that includes information I might need for my studies</td>
<td>90%</td>
</tr>
</tbody>
</table>

We asked the respondents to indicate the characteristics of ontology-based e-learning that he had used to classify them according to how they have improved their learning, on a scale ranging from negative to positive. More than 97% of respondents answered this question and the results shown in Table 5. The most used were the lecture notes, messages, e-mail, course manual and the linked pages. The best of these were lecture notes, messages and e-mail.

There was strong positive connection between a student has used a property is assessed and rated it as an improvement (Table 5). But the low rating may simply show that the devices in question may not be used in its ontology-based e-learning modules. For example, the low rating of "multimedia" in able 4 is not echoed by some students in our focus groups who had suffered much appreciated and its use.
Table 5. Students’ use of ontology-based e-learning elements and their rating of learning enhancement due to the followings feature.

<table>
<thead>
<tr>
<th>ontology-base learning element</th>
<th>Percent using</th>
<th>Mean rating</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lecture Notes</td>
<td>92</td>
<td>4.0</td>
</tr>
<tr>
<td>Announcements</td>
<td>88</td>
<td>3.6</td>
</tr>
<tr>
<td>E-mail</td>
<td>92</td>
<td>3.7</td>
</tr>
<tr>
<td>Assessments</td>
<td>80</td>
<td>3.4</td>
</tr>
<tr>
<td>Course Handbook</td>
<td>94</td>
<td>3.1</td>
</tr>
<tr>
<td>Websites</td>
<td>75</td>
<td>2.9</td>
</tr>
<tr>
<td>Past Papers</td>
<td>53</td>
<td>2.2</td>
</tr>
<tr>
<td>Discussion</td>
<td>58</td>
<td>1.9</td>
</tr>
<tr>
<td>Multimedia</td>
<td>42</td>
<td>1.5</td>
</tr>
<tr>
<td>Drop Box</td>
<td>38</td>
<td>1.2</td>
</tr>
</tbody>
</table>

6.16 Students’ opinions on training needs for e-learning

We asked students what they felt about the amount of training they had received on ontology-based e-learning use, either at IT induction or at the start of ontology-based e-learning modules. Those responding recorded the opinions shown in Table 6. Blackboard training has only been an integral part of core IT induction since the start of session 2003-4 and hence these results are difficult to interpret (other than indicating a broad degree of satisfaction), because the group surveyed was a mix of students with greatly differing IT induction experiences.

When we explored training for e-learning further with the focus groups, the students explained that they felt that a single training exercise was sufficient. They acknowledged that each ontology-based e-learning module differed slightly, but said that they enjoyed exploring the resources on each module and did not feel they needed to be guided through each one in turn.

Table 6. Student opinion on the amount of training received.

<table>
<thead>
<tr>
<th>Amount of Blackboard training</th>
<th>Percent responding</th>
</tr>
</thead>
<tbody>
<tr>
<td>Too little</td>
<td>25</td>
</tr>
<tr>
<td>About right</td>
<td>68</td>
</tr>
<tr>
<td>Too much</td>
<td>9</td>
</tr>
<tr>
<td>No opinion</td>
<td>18</td>
</tr>
</tbody>
</table>
6.17 The value of ontology based e-learning management system

Not surprisingly, 78% of respondents stated that he considered the proposed system is or can be very valuable for learning and training needs, 26% felt that it was very valuable, 17% that it was quite valuable, and only 11% were uncertain or not.

![Bar chart showing the value of E-Learning](image)

6.18 Respondents’ opinions on distinction between traditional learning and E-learning

As a first discussion, we divided focus groups in two groups and asked in what later became the effective learning as learning in traditional forms of learning and e-learning. Opinion groups and different languages, it has been difficult to take out and a consensus the report view. We asked the groups of the usefulness of his trial, the ontology based on the use of e-learning is and can be helping for learning. “Usefulness ” is defined as helping them learn faster, clearer, deeper, simpler, more flexible and simpler than traditional methods.

The group found that when used properly, the ontology based on the use of e-learning was useful. Everyone has different views on an excellent one student said that in the 3rd appointment of work linked to the subject of ontology-based e-learning use, another said to see some visual components had helped their understanding. Some students said they do not believe that the ontology based on the use of e-learning provides faster learning, but agreed that evidence of training would help to accelerate learning.

I asked them what they would suggest like students to engage more with the ontology based on the use of e-learning modules. In short, they replied as follow:

- The material would be more incorporated with other teaching
- There must be more online tasks and assessments
- The digital drop box needs to be used properly
- If there were more computers on campus to allow better access
- If all elements of prerequisite were compatible with the ontology-based e-learning
• If the ontology-based e-learning integrated question papers, model answers and opportunities to practice Exams
• If the ontology-based e-learning facilitated contact with lecturers – including getting to know about their Background and research interests
• If lecturers included bullet points to help with note-taking

6.19 Advantages and disadvantages of using technical platforms for education

Many contrasting views were expressed about the benefits of technological platforms for education. The students gave essentially similar answers to a pair of questions asking ‘what makes you use the ontology-based e-learning?’ and ‘what value do you gain from it personally?’ They highlighted the following characteristics:

- Flexibility
- Convenience
- Having to do a test
- Helps motivate students
- Needing to gain information
- Ease of access to information
- Potential for re-use of content
- The ability to find lecture notes
- The presence of announcements
- Needing to find out about deadlines
- Students can learn at their own pace
- Ability to supervise students at a distance
- Facilitates the management of student records
- Safe digital environment for students to submit work
- Where lecturers have helped to fillet out the ‘good stuff’
- Combination of both synchronous and asynchronous learning
- Enabling of quality education for increasing numbers of students
- The potential for interactivity amongst and between learners and teachers

Some negative comments which I got from the respondents

- Disadvantages which I have received from respondents are that many people are not familiar with most of these platforms by which there mean both lectures and students and as a consequence of this has been an obstacle, conferences, and many students do not have access and to present the latest platforms, and many thought that are also expensive to manage these platforms.

- There are many problems. Our school is for away from the city. Many times we have had technical problems. The advantages are many. When it works properly, we can experience good communication and a prompt this one is an advantage.

- Need for high availability of teachers, costs for students who do not have computer and Internet and go to Internet cafe and pay one more thing is that less cooperation between students, educational heterogeneity between different courses.
6.20 Discussion

Web Ontology Language is a specification for the representation of knowledge in e-Learning System, adds features of networked logic and knowledge representation. By joining these major strategies for knowledge representation, domain knowledge in e-learning provide fairly good expressive power and computational costs. Ontology as a basis for the assessment of knowledge evaluation emphasizes the dynamic potential evidence in the testing process for students. From teacher’s point of view, to test a student is given to teachers, where teacher simply enter the name of the test and select the number of issue cycles. In addition, the students will probably never be the same question during the evaluation of Ontology based system. Student data is very positive in many respects. Major and most important difference is the reading accuracy of the content of learning, which means a better understanding of the test questions. The other important difference is a refined and simplified user interface features that make the system more user-friendly and easy to use.
Chapter 7: Conclusion

After the study, we think that Semantic Web leaves its impact on information technology and different research areas such as Knowledge Engineering / Management, Software Agents and Web Services. An important objective of the Semantic Web is to hand over most of the information to software agents that we are doing by ourselves now a day on the web. Although the Semantic Web has achieved many milestones, but still it faces many challenges in the form of a vision to reality. This report used the combined qualitative and quantitative research methodology to find out the specific requirements of academia with respect to e-Learning. In order to gather the data collection, researchers used the case studies with observation in academia. All the steps are detailed for the case studies including background, related work, research questions, procedures, data collection, data analysis and expected outcome. The outcome of the qualitative study shows that academia needs an efficient e-Learning framework, which gives relevant results. After gathering the requirements, research proposed an ontology-based e-Learning framework (O-BEMS), whose basic objective is efficiency and relevancy. After proposing O-BEMS, researchers developed a search engine using PHP and MySQL, which is based on O-BEMS. In order to verify the results of this O-BEMS based search engine, researchers conduct an experiment with academia. Subjects for that experiment are taken from the academia. All the steps are detailed for the experiment including definition, hypothesis formulation, variable selection, subject’s selection, experiment design, execution plan, validity evaluation etc.
CHAPTER 8: FUTURE WORK

I think there is a variety of challenges in representing information on the web and there are increased demands and expectations for making information available both for humans and software agents. Human being wants to express their information in a more natural way, whereas software agents require specific formal representations. A satisfactory solution to web information representation requires minimizing the investment that humans must make, while still satisfying the software agents demands. Ontology engineering is facing some real challenges and needs more concrete and tangible work particularly on ontology based e-learning applications. Enterprise level service oriented infrastructures, e-learning, health informatics, financial institutions, smart information grids and crime control are particular areas where semantic mark-ups has special potential to play their role in near future.

My proposed framework is not mature one, because I focused on visual semantic web development and its limitations. I just tried to go an overview that how proposed ontology based e-learning management system works. It is an implementable form as far as a smaller or a medium learning organization, but in the case of a bigger learning organization I think we need to add some more semantic and ontological relations between different metadata. I suggest that we should be worked on this ontology based management system and implement it in the learning organization.
REFERENCES
[1] Ljiljana Stojanovic, Steffen Staab and Rudi Studer, “eLearning based on the Semantic Web”, FZI Research Center for Information Technologies at the University of Karlsruhe, 76131 Karlsruhe, Germany.


APPENDIX

Following is a set of questionnaire that was used to conduct an academia survey. This questionnaire was given to the practitioners of academia to get their feedback. We have tried to cover every aspect of our research area in these questions to know all academia practices with respect to e-learning management system and practitioner’s views.

1) What is the difference between traditional learning and e-learning system?

2) Do you like the Interface of the System and it is easy to access it?

3) Does the content of e-learning management system fulfill the needs of student if not then what do you suggest?

4) Do you think that in e-learning management system instructor and learner has a good coordination?

5) Is it beneficial to transfer campus component to online learning system?

6) Will you get quality education by adopting the e-learning system as compare to someone who gets in a traditional way?

7) Embedded materials are easily accessible?

8) Which facilities you have from e-learning and how much access you have on the system?

9) E-learning claims to improve the performance of student. What is your opinion on it?