The Need of Semantic Web Technologies Integration with Web-based Educational System

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Abstract— One of the major challenges in e-learning development is search and discovery of an appropriate learning content, among the distributed content repositories according to the contextual and personal interests of the learner. The technique like conventional keyword-based search appears to be not an efficient approach for searching the resources on the web. According to several researchers semantic web-based educational system has been the promising interaction environment for the next generation e-learning system. The major purpose of this paper is to explore the importance of integrating the Semantic Web technologies into e-learning domain and presents the current state of the art in the area of the semantic web technologies and their integration within the e- learning system. It also discusses some of the important issues that need significant improvement in intelligent e-learning systems.

Keywords— Metadata, Semantic-Web, E-Learning, Learning Object, Ontology, Issues in E-learning

I. INTRODUCTION

The Web-based Educational System offers advantage to learner by making relevant educational resources accessible at any time or place. The Internet-enabled learning is not just concerned with providing easy access to learning resources, but is also concerned with supporting features such as personalization, Adaptation, recommendation etc. Many e-learning applications are highly monolithic and seriously lacking in flexibility. The kind of intelligence enabled by Semantic Web Technology, such as software agents and self-describing systems, are not taken into account in the design of internet enabled educational system [1, 2].

The paradoxical situation of the e-learning community is lacking in knowledge representation technology. For this reason, Semantic Web technology has not been extensively used and studied for educational applications, therefore there is a need of detailed analysis from the e-learning community concerning Semantic Web infrastructures. Along with this there is a need of study on Learning-objects (self-contained and re-usable unit of learning) that provides conceptualization of the learning process. The concept of learning objects is generally based on the use of metadata (external information structure) to facilitate their identification, storage and retrieval.

Metadata is physically external to the educational resource; they can be in a separate file or be obtained from a different service. The most important issues for searching learning materials which are considered by the learners are:

- Content: What the learning materials about.
- Context: In which form learning material is presented.
- Structure: How a set of learning materials merge and create a learning course.

The resource discovery based on Content, Context and Structure within a heterogeneous collection of resources is a challenging problem. Therefore, by using ontology (a formal description of the knowledge in a domain) in each of the above mentioned issues, improve web based education significantly.

This paper gives an overview over the issues that need significant consideration in e-learning systems and the use of semantic web technology to provide a new perspective for next generation web-based learning management system. Finally we look over in to the Metadata Enrichment stages and ontologies that helps in searching and discovery of an appropriate learning object among the distributed content repositories, that significantly improve web based education.

II. PROBLEM DEFINITION

New technologies have a powerful influence on all aspects of our society; there is an increasing interest of researchers on using new technologies to improve education [3]. Technology and online communications are dominant forces in current e-learning industry. As new technologies have been integrated into online learning, students have been more exposed to learning skills, educational resources, getting extra help in a subject having trouble with, and provide ability to review the material as many times as they wanted.

The major role of the technology is to actively support the whole learning cycle, such as learning content management, delivery/search process and presentation environment. The course curriculum content may come in many forms, formats, from different departments, with different internal structures and even in different languages. The ontology-based approach is able to provide support for capturing in a single framework, to model the curriculum content management requirements.

E-learning standards are now starting to have a real impact in the Web based field of education [4].The metadata standards such as IMS Global Learning Consortium (http://www.imsglobal.org/), IEEE Learning Object Metadata (http://ltsc.ieee.org/wg12/index.html), and Dublin Core Metadata Initiative (http://dublincore.org/) are engaged in the development of interoperable online metadata standards, that has initiated the growth of e-learning applications and learning object repositories. In the current e-learning industry, most learning management systems (LMSs) work in a closed-system manner.

Some systems still use their own framework for learning content description rather than adopting Learning Object Metadata as the main standard. The current existing metadata standards are not providing fully educative support information and also they are not completely suitable enough to integrate Semantic Web technologies into e-learning domain.

Nowadays, web-based educational systems are facing challenges that include: Semantic based presentation, retrieval, structuring of learning resources and context aware adaptation, recommendation, and personalized delivery as per the learner needs. It is also required to consider the cognitive prerequisites of a learner, as an important step towards delivering contents of a domain.

For the recent development in semantic-web technology and the pedagogical requirements of e-learner there is a need to redefine the existing metadata standards using ontological approach (Semantic based description) to make them suitable for current requirements Educational Semantic Web Vision.

III. ISSUES IN E-LEARNING DOMAIN

In this section we discussed some of the most important issues that need significant improvement in web-based intelligent e-learning systems.

A. Metadata Heterogeneity

Different communities have developed their own metadata. Because of this variation and heterogeneity, different metadata cannot work with each other. Creating a common understanding between terms in various metadata, vocabularies can be helpful in content modelling. This is the most important issue for searching learning materials in distributed educational environment.

B. Personalized Delivery

From the learner's perspective the educational content server must possesses enough intelligence to arrange for personalization of the learning tasks it supports. The server has to act as an intelligent tutor with both domain and pedagogical knowledge to frame and deliver the learning session.

C. Collaboration

By using educational models of different students the system have to form a matching group of students for different kinds of collaboration. The system also has to operate differently for different category of learners through considering information and knowledge from their activity.

D. Pedagogical Agents

Pedagogical agents need to support both collaborative and individualized learning, as well as they needs to help in improving the students' cognitive learning processes. The intelligent pedagogical agents have to provide the necessary infrastructure for knowledge and information flow between the clients and the servers of learning resources.

E. Dynamic Assembly

Dynamic assembly of these learning objects is based on the relative match of the learning object content and metadata to the learner's needs, preferences, context, and constraints. Dynamic Assembly have to include the process of connecting relevant search results into a learning path, sequencing the selected learning objects on the path, and linking the selected learning objects into an organized structure.

F. Effective Content Discovery

One of the major challenges in e-learning development is search and discovery of an appropriate learning object among the distributed content repositories. Although SCORM presents some approaches for content reusability, but efficient searching process is a significant problem yet. We need an effective searching mechanism for discovery and access to the

required learning resources, to utilize them in our courses. But resource discovery within a heterogeneous collection of resources is a challenging problem. Semantic web has been proposed for resolving the problems.

G. Formal Framework

A formal framework is required for the discovery, selection, composition and negotiation of learning objects using a semantic service-oriented substrate. The Framework will be extensible so that it can be applied to solve the eLearning needs of multiple organizations.

IV. EDUCATIONAL SEMANTIC-WEB

Technology is empowering students to take responsibility for their own learning and giving them opportunities to create more personalized learning experiences.

E-learning is not just concerned with providing easy access to learning resources anytime, anywhere, via a repository of learning resources [5], but it is also concerned with facilitating student-centered learning and to improve students' learning outcomes. As the Semantic Web is extending an idea of incorporating intelligence or meaning to the existing web [6], the semantic based structuring of course contents using ontological approach can provide more adaptable and intelligent learning environment. It exposes the learner to higher order thinking skills and making them to interpret the correlated concepts of learning domain.

Semantic e-learning is a group of technologies, protocols, processes and techniques [7]. Thus, issues and challenges concerned to various levels of Semantic e-learning technology must be handling before the next generation of e-learning.

A. Metadata

As shown in Figure.1 the educational semantic web needs the metadata elements to support structural, semantic, educational and contextual descriptions of educational resources. But the current metadata elements are generic terms which are not specifically designed and developed for educational domain [8] so that, they are just useful for the purposes of content management and structural description of learning material.

But, in order to make learning material identifiable by search engines they are not much supportive for semantic or contextual description of learning material. The introduction of formal semantics into existing metadata standards is one of the challenges that the metadata standards have been dealing with [9].

B. Ontology

Most of the researchers still remain with XML based technology for meta-data, even though there are many potential benefits with semantic web technology. Ontology is potentially very useful in Semantic Web technology, as it identifies the relationships between concepts in a domain and it is one of the most popular approaches for reducing the problem of data and format heterogeneity in e-learning domain.

The architecture of e-learning environments based on semantic web technologies require to develop Educational Ontology such as Domain Module Ontology, Student Module Ontology, Pedagogical Module Ontology, Adaptation Ontology, task ontology, Context Ontology, and so on for the purpose of communication, management, presentation and retrieval of the learning material and the construction of e-learning ontology is not a simple task, it involves domain experts.

C. Agents in e-Learning

Agents play an important role in Semantic Web-based Educational Systems [9]. The role of agents in the development of e-learning systems is to improve the collaboration in the e-learning environment. The agents in e-learning domain can help in facilitating the design of appropriate educational material and its delivery in a personalized way, with the level of difficulty which suits the learner's ability [10].

The pedagogical agents are of the special research interest in student's based self learning and Personalized Learning environments.
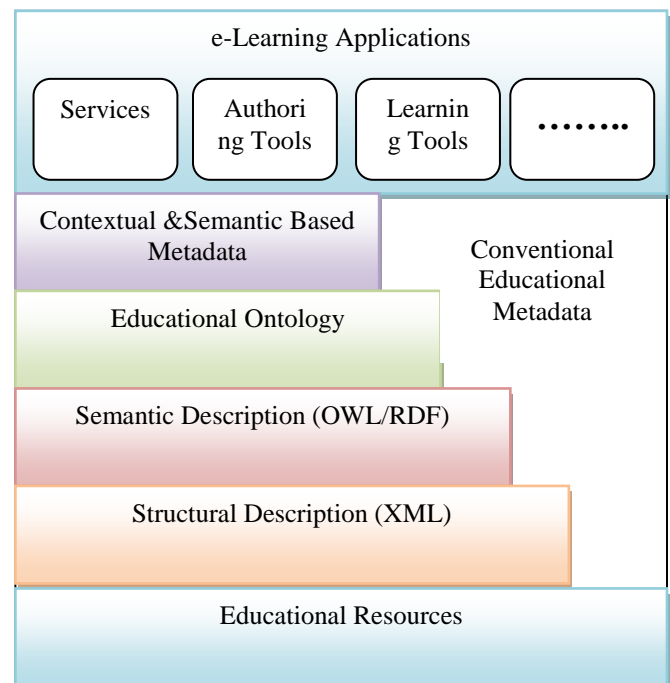

Figure 1. Stack of Metadata Enrichment of Educational Semantic Web

V.   CONCLUSION

The semantic web technology can help in structuring the huge amount of e-learning resources and modeling learner characteristics so as to deliver learning resources in a personalized way. The ontological framework strengthens the metadata of learning resources and makes e-learning domain to cope-up with Educational Semantic-web Vision. In this paper, we discussed some of the most important issues that need significant improvement in web-based intelligent e-learning systems and the need of ontological approach to support Educational Semantic-web Vision. In addition, a discussion about the introduction of formal semantics into existing metadata standards

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