Some Properties of Semantic Web in e-Learning

M. Haghshenas, H. Kabir, and M. Khademi

***Abstract*—Researches in the field of E-learning are represented by a broad spectrum of applications, ranged from virtual classrooms to remote courses or distance learning. E-learning is not just concerned with providing easy access to learning resources, anytime, anywhere, via a repository of learning resources, but is also concerned with supporting such features as the personal definition of learning goals, and the synchronous and asynchronous communication, and collaboration between learners and between learners and instructors. Nowadays, the web has become an important learning platform. Not only its accessibility has made it a successful environment, but also when the Semantic Web is used, learners will be able to add extra materials and links to the learning objects for their own benefit or for that of later learners. This paper discusses the potential of semantic technology for supporting learning content in E-learning environment.**

***Index Terms*—E-Learning, ontology, semantic web, XML layer.**

I. Introduction

E-learning aims at replacing old-fashioned time/place/content predetermined learning with a just-in-time/artwork-Place/customized/on-demand process of learning. It builds on several pillars, viz. management, culture and IT [1]. E-learning needs management support in order to define a vision and plan for learning and to integrate learning into daily work. It requires changes in organizational behavior establishing a culture of "learn in the morning, do in the afternoon". Thus, an IT platform, which enables efficient implementation of such a learning infrastructure, is also needed. Our focus here lies on IT (Web) technology that enables efficient, just-in-time and relevant learning. Current web based solutions don't meet the above mentioned requirements.

Semantic Web is an extension of the current web in which information is given well-defined meaning, better enabling computers and people to work in cooperation [2]. The Semantic Web initiative aims to support explicit semantics and its automated processing. E-learning is an area that can benefit from Semantic Web technologies. Recent advances in technologies for web-based education provide learners with a broad variety of learning content available.

Manuscript received October 12, 2012; revised December 22, 2012.

M. Haghshenas is with IT management at Islamic Azad University, Science and Research branch, Tehran, Iran. (e-mail: m.haghshenas@srbiau.ac.ir).

H. Kabir is with Shahid Beheshti university, Tehran, Iran (e-mail: h.kabir@mail.sbu.ac.ir).

M. Khademi is with the faculty member of Islamic Azad University, Tehran south branch, Iran (e-mail: khademi@azad.ac.ir).

Numerous resources may be used during E-learning education. Some are internal and made by several factors implied in the E-learning, others are available on the web, such as online courses, online forums, course supports, slides, bibliographies, frequently asked questions, lecture notes, and so forth. Ontologies are a way of representing such formal and shared information. They can be used to index data indicating their meaning, thereby making their semantics explicit and machine-accessible.

In this paper we illustrate the Semantic Web features and present its advantages in E-learning.

II. Semantic Web Layers

The current WWW is a powerful service for research and education, but its utility is hampered by the inability of the user to navigate easily the nefarious sources for the information he/she 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 [3]. The idea is that the web content and accompanying semantics (or metadata) will be accessed by web agents, allowing these agents to reason about the content and produce intelligent answers to users' queries.

The Semantic Web, in practice, comprises a layered framework: an XML layer for expressing the web content; a RDF[1] layer for representing the semantics of the content; an ontology layer for describing the vocabulary of the domain; and a logic layer to enable intelligent reasoning with meaningful data [4].

XML was designed as a simple, flexible way of transporting structured documents across the web. XML is machine-readable, i.e. programs can read and understand it, but the program developer has to know what the page writer uses each tag for. In other words, XML allows users to add arbitrary structure to their documents but says nothing about what the structures mean [2].

The meaning of document content is expressed with RDF that is simply a data model and format that allows the creation of machine-readable data. It comprises a set of triples, i.e. Three URI[2] that may be used to describe any possible relationship existing between the data – subject, object and predicate. Thus, all data stored in the system is easily readable and process able. It is important to note that RDF provides the syntax, but not the actual meaning of the properties we ascribe to the data. A learning object, may include a set of properties such as Course, Sub-Section, Author, Title, Rating, etc. Thus, for every domain there is a

[1] Resource Description Framework
[2] Universal Resource Identifiers

need for a specific ontology to describe the vocabularies and to make sure they are compatible.

Ontologies 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 different Semantic Web applications can communicate by exchanging their ontologies. Several representation schemes have been defined for this layer.

The implementation of logic layer will allow the user to state any logical principles and permit the computer to infer new knowledge by applying these principles to the existing data. Since there are many different inference systems on the web that are not completely interoperable, the vision is to develop a universal logic language for representing proofs [6].

III. The Semantic Web and e-Learning Main Concepts

The Semantic Web has opened new horizons for internet applications in general and for E-learning in particular. The E-learning community is aiming at having much more effective services than what is currently provided by any of the available computer aided tutoring, or learning management systems. Nowadays, knowledge is distributed throughout the web on millions of pages, PDF files, multimedia and other resources.

Learners and researchers need vast amount of material and Spend considerable amount of time trying to learn about a particular subject. The concept of Semantic Web is adding powerful features to the web. The focus of internet research is targeted towards creating a global decentralized knowledge based system; hence the term Semantic Web is introduced as: "a vision for a next-generation network that lets content publishers provide notations designed to express a crude meaning of the page. Autonomous agent software can then use this information to organize and filter data to meet the user's needs". However, regardless of the time or expense put into creating advanced learning content, the content is useless unless it can be searched and indexed easily [7].

One solution is to use ontology. Ontology is defined as an "an explicit specification of a shared conceptualization", where conceptualization refers to the objects, concepts, and other entities that are assumed to exist within some domain of interest and the relationships that hold among those entities, in other words, ontology helps us to make the knowledge represented in the E-learning content explicit. This significant for using ontologies are the sharing of common understanding between human and computer, reuse of domain knowledge, making domain assumptions explicit, the separation of domain knowledge and the operational and analysis of domain knowledge.

Onthologies have the potential to facilitate the creation of semantic relationships between various pieces of relevant and useful information, which is the backbone of Semantic Web, to enhance the learning experience in an E-learning environment. Onthologies can also facilitate provision of consistent vocabulary and word representation for clear communication within knowledge domain. Ontologies have been widely applied in the context of integration and representation of various knowledge resources [3].

IV. The Usage of Semantic Web in a Learning Context

Traditionally, a learning resource can be made accessible on the web and then (possibly) updated by the provider. Using a learning framework equipped with Semantic Web techniques we may also do the following to a resource [7]:

Describe it: Since a resource can use outside the domains foreseen by the provider, any given description (metadata instance) is bound to be incomplete.

Certify it: There is no reason why only big organizations should certify learning resources. Individuals, may want to certify certain content as a quality learning resource that is well suited for specific learning tasks[3].

Annotate it: Everything that has an identifier (URI) can be annotated. Annotea is a project where annotations in RDF format are created locally or on a server. The annotations apply to HTML or XML documents and are automatically fetched and incorporated into web pages [8], [9].

Extend it: Structured content is becoming common. Successive editing can be done via special RDF-schemas allowing private, group consensus or author-specific versions of a common base document.

Use it everywhere: RDF is application independent. Since the metadata is expressed in a standard format, which is independent of the underlying schemas, even simplistic applications can understand parts of complex RDF graphs. If your favorite tool does not support the corresponding schemas, it can at least present them in a rough graph, table or whatever standard form it has for describing resources and their properties. If more advanced processing software is available more advanced treatment of the RDF descriptions is possible.

And more: Apart from these uses, you can invent new schemas describing structures, personalization, results from monitoring and tracking, processes and interactions that can enrich the learning environment in various ways.

V. Technology Benefits

The key ideas of Semantic Web, namely common shared meaning (ontology) and machine-process able metadata, establish a promising approach for satisfying the E-learning requirements. Expectations for this technology contribute to longer term aim of educational change which includes increasing the effectiveness, the flexibility and accessibility and attractiveness of education and also decreasing the workload for staff.

Thus the relevancy of this Semantic Web technology for E-learning education depends on how much it contributes in the accomplishment of these aims. When we are able to represent E-learning courses in a semantic way, it opens the possibility to realize the needs of E-learning education:

- Sharing and re-use of learning content is one of the objectives in the field of E-learning, more specifically learning objects. This sharing and reuse is needed to make course development more efficient.
- Adaption to individual learner characteristics is highly desirable since no two learners have the same learning pre-requisite, skills, aptitudes or motivations.

- Learning content dynamically changes constantly through learners and tutors, interactions, input, experiences or new practices. The Semantic Web enables the use of distributed knowledge provided in various forms, indicated by semantically annotation of content.
- Nonlinear Access. Knowledge can be accessed in any order the learners wishes, according to his/her interests and needs. This can be done by performing semantic querying for the suitable learning content [10].

The Semantic Web has the means to assist instructors in course development, learner support, assessment, record keeping and document control tasks. Smart agents can coordinate learner and instructor calendars to schedule meetings. These software agents can also provide instructors with new information relevant to their area of expertise and professional interests. An educational Semantic Web can define and structure virtual reality environments to "real work and study contexts". Learner personalization "presents only the information that is really relevant for the learner, in the appropriate manner, and at the appropriate time" [9], [10].

Ounas, Davis, and Millard (2008) offer a framework for using the Semantic Web to form optimal collaborative Learning groups. Learner features are modeled using ontologies to form reliable dynamic learner profiles. Modeled features include personal details, course details, interests, team roles, preferences, and social connections. The semantic representation of learners' data allows inferences from Mined data to create missing data. "The Semantic Web offers learners the possibility of having a wealth of related content delivered to their desktop without explicitly identifying or requesting it." Content stored within virtual worlds, can be used by instructors to enhance learning experiences and provide relevant learning interactions to learners [9].

Learners will also benefit from knowledge construction powered by the Semantic Web. A Semantic Web search will return a multimedia report rather than just a list of hits [11]. Smart agents will assist learners in documenting and archiving their learning products, locating resources, and working collaboratively. Reynard observes, "Having integrated data also means that learners can develop skills based on integrated information".

VI. Conclusion

The Semantic Web and its benefits could result in more flexibility in the creation and management of E-learning content and, as a consequence, will reduce cost. The wealth information available in our E-learning content can be harnesses using Semantic Web technology with incorporating pedagogical theories and processes to provide a complete paradigm change towards more active-learning environment. Ultimately, the learners will benefit from these through extended availability.

References

[1] H. Maurer and M. Sapper, "E-learning has to be seen as Part of General Knowledge Management," in *Proc. ED-MEDIA 2001 World Conference on Educational Multimedia*, pp. 1249-1253, 2001.

[2] T. Berners-Lee, J. Hendler, and O. Lassila, "The Semantic Web," *Scientific American*, vol 284, no. 5, pp. 34-43, 2001.

[3] T. Berners-Lee. Semantic Web Roadmap. [Online]. Available: www.w3.org/Design Issues/Semantic.html.

[4] T. Bray. What is RDF? [Online]. Available: www.xml.comorg/pub/a/2001/01/24/rdf.html.

[5] L. Yu, *Introduction to the Semantic Web and Semantic Web Services*, Boca Raton, FL: Chapman & Hall/Crc, 2007.

[6] R. Reynard. Web 3.0 and Its Relevance for Instruction. *The Journal*. [Online]. Available: Http://thejournal.com/ web-3.0-andits-relevance-for-instruction.aspx, 2010.

[7] H. Keynejad, M. Khademi, M. Haghshenas, and H. Kabir, "E-learning Content Authoring Tools and Introducing a Standard Content Constructor Engine," presented at 2nd International Symposium on Computing in Science & Engineering, June 2011.

[8] V. Devedzic, "Semantic Web and Education," *Integrated Series in Information Systems, Springer*, vol. 1, 2006.

[9] C. Daly. The Semantic Web and E-learning. E-Learn Magazine: Education and Technology in Perspective. [Online]. Available: Http://www.elearning.org/subpage.cfm?section=articles&article=77-1, Aprill 2009.

[10] H. Hashim, "New Chalengs for e-learning: supporting learning content through semantic web technology," *Educational Technology & Society*, 2004.

[11] J. Ohler. Web 3.0 - The Semantic Web Cometh. *Docstoc*. [Online]. Available: http://www.docstoc.com/docs/25619755/web-30---The-Semantic-Web-Cometh, 2008.

M. Haghshenas was born in Bijar in 1985 and has earned B.Sc. degree in Computer Hardware engineering from Islamic Azad University, South Tehran branch, Tehran, Iran in 2007. Then she received M.Sc. degree in IT management at Islamic Azad University, Science & Research branch, Tehran, Iran in 2011.

She was Network Technician in Pars company on 2007 then project manager of IT systems Department in Gilas computer company on 2010, Now, she is working in Professional services Department in Magfa (IT Development Center November 2011). Magfa ITDC an affiliate of the Industrial Development and Renovation Organization of Iran, IDRO, assumed its responsibility to develop and renovate Industries by promoting ICT and its applications, and to play a major role in globalizing the Iranian ICT Industry through joint investments with the private sector. She has published "Information technology security & service management system" in Information Society of Iran journal on July 2010, and the other publication in different fields .She is interested in construction of content in E-learning & Indexing on components of multimedia, categories of authoring tools and IT Systems .

Ms. Haghshenas is a member of Young Researchers Club at Islamic Azad University-Science and Research branch in Iran.

H. Kabir was born in London in 1985 and has earned a B.Sc. degree in Computer Software Engineering from Islamic Azad University, south Tehran branch on 2010 and is M.Sc. degree student in IT engineering at Shahid Beheshti University. She is interested in producing E-learning content, Enterprise Architecure.

M. Khademi was born in 1967 in Borujred, Iran. She received the B.Sc., M.Sc. and PhD degrees from Tarbiat Moaalem University in 1989, Iran University of Science and Technology in 1991, and University of Tehran in 2004, respectively. She is the author or coauthor of more than sixty-five articles in national or international journals and conferences proceedings and also collaborated in several research projects. She wrote a book entitled "Advanced Engineering Mathematics", 2011 and has cooperated in translating two books, namely "Calculus and Analytic Geometry, George Thomas Brinton", 2010 and "Research to Manuscript, Micheal Jay Katz", 2012. Her current research interests include finite group theory, graph theory, modeling and optimization, image processing, handwriting recognition, artificial intelligence and data mining. She is a faculty member of the department of applied mathematics in Islamic Azad University, South Tehran Branch, since 1991.