International Journal of Scientific and Technical Advancements
IJSTA
ISSN: 2454-1532

Perspective Technologies in E-Learning- A Review

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***Abstract*—**E-Learning encompasses the use of technology to search, share, compare, organize and reuse contents. E-Learning has brought revolutionary changes in the learning approaches. E-Learning is also an ever advancing field owing to the developments in the World Wide Web and the Semantic Web technologies. E-Learning is changing from passive to active and the personalized involvement of learner is also becoming more and more dynamic. Personalized learning has been envisaged as active, assessment-rich, meta-cognitive and transformative. As the learning objects become more and more robust, there is a need for better and more capable learning services to make fitting use of these learning objects. The presented paper is a review of the evolution of the e-Learning systems, the short comings of the earlier e-Learning platforms, the current trends and the future requirements. The paper also discusses the scope and the role of semantic web technologies in achieving the interoperability and personalizability of the e-Learning services and e-Learning objects.

***Keywords*—** e-Learning; semantic web; evolution of e-Learning systems.

I. INTRODUCTION

The advent of the World Wide Web had its repercussions in every possible field. The developments which have taken place in the pedagogy of teaching and learning are significant. The learners are no more constrained by the physical boundaries of classrooms or the geographical boundaries of countries. The learners today have freedom to adjust their learning schedules and levels according to their time and requirements. The people who are in-service, have time-constraints or are differently-abled, can also use e-Learning to enhance their skills and advance in any contemporary field of knowledge. Archaic methods of traditional passive learning have now transformed to dynamic and active learning which is more assessment-rich and meta-cognitive.

The beginning e-Learning systems simply comprised of learning system which used media or the use of computer in any form. The electronic presentations, lectures stored on disks and CDs etc. all encompassed the e-Learning system. At the architectural level, there was no difference between learning services and content. The development of the content and the services went hand in hand. There was no abstraction between the two. The earlier LMS provide a suite of tools for the creation, maintenance and delivery of online courses. The tools were provided for the enrolment and management of students; the overall administration of the education; and the reporting of student performance and feedback. LMSs exist, both, as open source initiatives like Moodle, SAKAI etc and proprietary solutions like Blackboard, Desire2Learn etc. Open source initiatives are built on extendable frameworks. An Indian initiative by IIT-Bombay, '*Brihaspati*' is also an extension and customization of Moodle.

Slowly, with the growth of internet, the e-Learning services and the learning objects began to be seen as separate entities. E-Learning service providers today develop learning objects and learning services independent of each other. The learning objects refer to the educational resources such as lecture notes, tutorials, case studies, reference material, tests, exams etc. Learning services are complete entities designed for a specific purpose and targeted at a specific audience [1]. Learning objects are of a more general nature and of a smaller granularity level. Educators and (semi-)automated tutoring systems compose learning services out of learning objects and other educational resources. The ever proliferating advancements in internet technologies, has given a new shape to the learning services and is continuously evolving for the betterment of the mankind. The technology has brought all possible resources at a click.

II. EVOLUTION OF E-LEARNING SYSTEMS

1. First Generation

The period from 1993 onwards marked the growth of e-Learning platforms. The earlier e-Learning platforms provided mainly black box e-Learning solutions. The approach adopted was "One size, fits all". The content was not customizable according to the needs and requirements of the end users. The focus was on the delivery of courses designed for a specific purpose and targeting audience. These systems were mostly proprietary solutions and were customized according to the needs and requirements of a specific viewer group. The content was not customizable. Many standards for interoperability of data emerged during this time such as Dublin Core, IMS Learning Resource Metadata, IEEE Learning Object Metadata etc. Contents which were compliant with these standards could be shared with other LMS of the same compliance. Interoperability between different platforms was facilitated at the content level through data communication channels. These channels recommended a common communication API to be included with all content, which supported features like launching and stopping learning content. The premier progression made during this time period in the development of e-Learning platforms was the support and the development of standards for sharing content in an interoperable way. The first versions of WebCT and Blackboard were developed during this period.

2. Second Generation

The second generation of e-Learning platforms began around the year 1999, when the focus shifted on sharing not

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only the learning content but also on sharing learning objects, sequences of learning objects and learner information. This is achieved through defining communication rules between client side content and the run-time environments. An import/export paradigm allows courses and parts of courses to be shared between standards compliant e-Learning platforms. Standards emerged during this time included SCORM, IMS Content Packaging and IMS Learning Design[2]. The Content Packaging includes defining standards for packaging together the content and its metadata. The learning objects developed using these standards is to a large extent machine readable. The tools designed for developing the content, the services for providing the content to the learner and the content itself began to be viewed as different entities. The systems became more modularized as compared to the previous monolithic ones. However, these systems do not give the prime importance to the learner rather the focus is on the course management. This generation marked a shift from the monolithic systems to modular systems. Tools and protocols were formed for the exchange of learning services. The content and the tools required for the development of the content began to be distinguished. WebCT/BlackBoard, Moodle, SAKAI are some of the examples of the e-Learning platforms belonging to this generation. The need for the capability of exchanging content between different systems was also recognized.

3. Current Trend

The continuous evolution and development of e-Learning platforms led from the monolithic (first generation) to customizable (second generation) systems to service-oriented (third generation) systems. The present trend is towards the development of service-oriented systems. The "service" framework is being applied to the modular design of the e-Learning platforms. The Learning Management System (LMS) and the Learning Content Management System (LCMS) are seen as separate entities. This supports much higher level of interoperability and facilitates not only the sharing of the learning objects but also the tools, functionalities, semantics and the controls in a seamless fashion. Web Services are being used for providing the e-Learning services.

III. FUTURE CHALLENGES

The e-Learning platforms in today's scenario are required to be more interoperable, flexible and personalizable, just-in-time and task relevant. With the growing bulk of data on the Web, it is getting difficult to mine out useful information. The information in Learning Objects is also required to be customized as per the needs, requirements and the skill set of the end user. The 'One size, fits all' approach is no longer found useful to serve the needs of the learner. Learning services need to be capable of providing functionalities like concept extraction, topic extraction, document clustering, information retrieval, perplexity reduction, polysemy and hyponomy extraction for making the content truly personalizable. The Learning Objects should be adaptable to the needs of the end user. Information is not only required to be exchanged across different environments but is also required to be transported across heterogeneous environments. To make this possible, dynamic semantic mapping is required to achieve interoperability in its true sense. E-Learning services cannot assumed to be a simple dumb content. They have all the vital information like their own internal representation, their own control flow etc. The e-Learning platforms must be capable of supporting the exchange of information between interoperating e-Learning services across the both, homogeneous and heterogeneous domains. The support for plug-ability and extendibility is also a must for the development of interoperable e-Learning systems.

IV. SCOPE OF SEMANTIC WEB TECHNOLOGIES

Semantic Web Technologies prove to be a promising solution to the challenges faced. The Semantic Web technologies, tools and standards form the basic building blocks of an infrastructure to support the vision of the Web with meanings. URI can be used to identify abstract or physical resources uniquely. RDF is a standard for data interchange on the Web. RDF has features that facilitate data merging even if the underlying schemas differ, and it specifically supports the evolution of schemas over time without requiring all the data consumers to be changed [3]. RDF may be used as a metadata language for representing information and it also provides a model for describing and creating relationships between resources.

```
<rdf:RDF
    xmlns:rdf="http://www.w3.org/1999/02/22-rdf-syntax-ns#"
    xmlns:rdfs="http://www.w3.org/2000/01/rdf-schema#"
    xmlns:foaf="http://xmlns.com/foaf/0.1/"
    xmlns:admin="http://webns.net/mvcb/">
<foaf:PersonalProfileDocument rdf:about="">
 <foaf:maker rdf:resource="#me"/>
 <foaf:primaryTopic rdf:resource="#me"/>
 <admin:generatorAgent
rdf:resource="http://www.ldodds.com/foaf/foaf-a-matic"/>
 <admin:errorReportsTo
rdf:resource="mailto:leigh@ldodds.com"/>
</foaf:PersonalProfileDocument>
<foaf:Person rdf:ID="me">
<foaf:name>Neha Jain</foaf:name>
<foaf:title>Mrs.</foaf:title>
<foaf:givenname>Neha</foaf:givenname>
<foaf:family_name>Jain</foaf:family_name>
<foaf:nick>Nannu</foaf:nick>
<foaf:mbox_sha1sum>
74daa438aab7faa44e2190848eb21c16ca3d063f
</foaf:mbox_sha1sum>
<foaf:homepage rdf:resource="www.abc.co.in"/>
<foaf:depiction rdf:resource="neha"/>
<foaf:phone rdf:resource="tel:12345678"/>
<foaf:workplaceHomepage rdf:resource="www.ju.ac.in"/>
```

Fig. 1. A sample RDF file.

RDF is the foundation on which richer Ontology development languages such as OIL, DAML+OIL and the most expressive one the OWL (Web Ontology Language) have emerged. OWL is the most prominent markup language available for publishing and sharing data using ontologies. Ontologies are the shared conceptualizations of the real world entities. They are referenced using URI which can be accessed

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globally. An ontology is an agreed vocabulary that provides a set of well-founded constructs to build meaningful higher level of knowledge for specifying the semantics of terminology systems in a well defined and unambiguous manner [4]. Ontologies can also be used to mine out new knowledge. Semantically annotated learning material can be easily customized according to the requirements of the course and the user requirements. Properly annotated learning objects may be imported and exported across various homogeneous and heterogeneous learning environments. Inference engines and Reasoners can be used to query the ontologies and to retrieve information and produce new knowledge. OWL for services (OWL-S) may be used to create this capability. Learning objects with learning content which is highly adaptable, personalizable and interoperable may be created with semantic web technologies.

WSDL [5] provides a description of the Web Service. WSDL provides a machine-readable description of how the service can be called, what parameters it expects, and what data structures it returns. SAWSDL [6] i.e. Semantic Annotations for WSDL and XML Schema defines a set of extension attributes for the Web

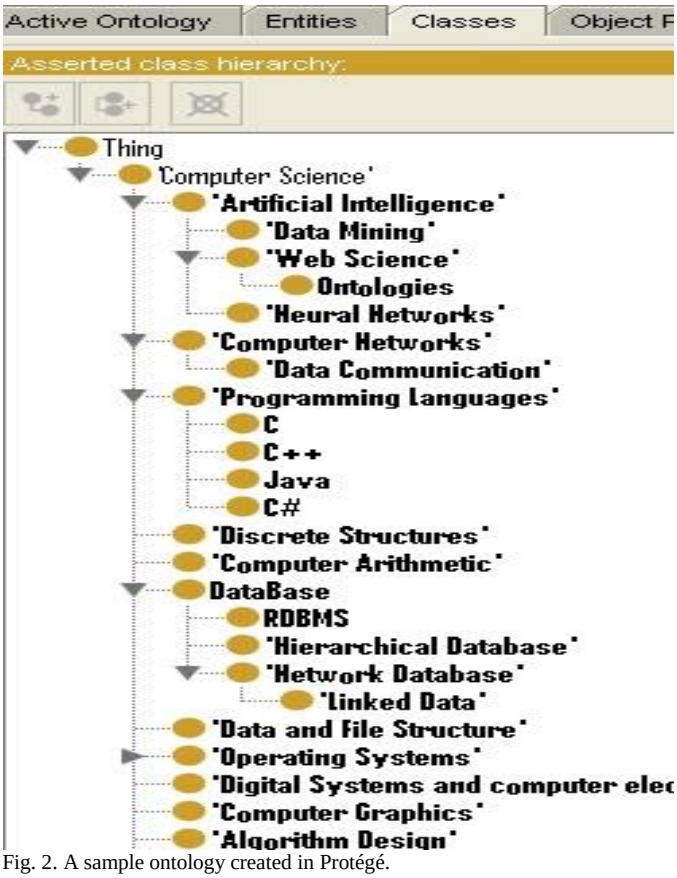

Fig. 2. A sample ontology created in Protégé.

Services Description Language and XML Schema Definition language that allows description of additional semantics of WSDL components. SAWSDL defines how semantic annotation is accomplished using references to semantic models i.e. ontologies.

Learning objects described with OWL can also be personalized. E-Learning Services which carry out personalization functionality like personalized search or personalized recommendation can also be annotated with OWL ontologies and accessed via SAWSDL. Various Personalization services may include Query rewriting service to match the needs of the user and the available services, a recommendation service which provide annotations for learning resources in accordance with the user profile and the learning objects accessed, a Link Generation service which provides (personalized) semantic relations for a learning resource in accordance with the information in the user's profile etc.

Both learning objects and learning services need to be enhanced semantically. Semantic Web Services offer a promising solution to the interoperability issue of the e-Learning services across varied heterogeneous domains. During the modelling phase, the e-Learning service provider can explain the intended semantics in a fair detail by annotating the appropriate parts of the e-Learning service with concepts from already established semantic model. Since semantic models provide agreement on the meaning and the intended use of terms, and may provide formal and informal definition of the entities, there will surely be less ambiguity in the intended semantics of the e-Learning service provides. These e-Learning services can be published and made available through registry. During discovery, the service client can describe the service requirements by means of terms from the semantic model. Reasoning techniques and tools prove capable in finding the semantic similarity between the service description and the request.

V. CONCLUSION

The e-Learning Platforms have evolved from monolithic systems to service oriented systems and are now heading towards semantic web service oriented systems. The learning content has transformed into learning objects which are interoperable among homogeneous environments. With the advent of Semantic Web Technologies, the learning objects will become interoperable even among heterogeneous environments. The LMS developed with semantic web technologies will be more learner centric and will be customizable and personalizable according to the learner.

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