

CHALLENGES AND BENEFITS OF THE SEMANTIC WEB AND THE SEMANTIC GRID FOR E-LEARNING

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ABSTRACT

The complexity of e-learning arises from requirements for dynamicity, interoperability, and semantics handling. Bringing semantics to learning content and services is to provide distributed information with well-defined meaning which is understandable for a wide diversity of parties. This paper explores the need for making the semantics explicit and machine-accessible and outlines the current state of the e-learning technologies specifically the Semantic Web and the Semantic Grid. The aim of this paper is to highlight what such learning technologies bring to e-learning.

INDEX TERMS

e-Learning, interoperability, Educational Web Services, Semantic Web, Semantic Grid

I. INTRODUCTION

There has been considerable interest in recent years in e-learning. It is the 'e' before 'learning' that gave birth to a new paradigm shift to conventional learning. The complexity of e-learning arises from requirements for dynamicity, interoperability among various educational systems and on the other hand, expressiveness, i.e., the semantics of the elements of the model should be understandable and reusable by both humans and machines. This interpretation presents a challenge of providing an e-learning infrastructure of knowledge based, context-aware collaborative learning services, rather than information based content delivery [1]. The major Web technologies including Web Services, Semantic Web, and recently Semantic Grid, have offered a promising vision of their support and enhanced the next generation of e-learning systems. In this paper, I shall discuss the need for bringing semantics to e-learning. This paper then focuses on the

main aspects of the Semantic Web and the Semantic Grid for e-learning and presents how they are complementary and what they bring to e-learning.

II. THE NEED FOR BRINGING SEMANTICS ON E-LEARNING

While resources on the Web (both static documents and functional components and software) are reaching critical amount they become almost impossible for the learners, authors and instructors to address their current needs, tasks, roles and goals. In short, they have insufficient knowledge – here knowledge is understood as information applied to achieve a goal, solve a problem or enact a decision. In other words, the different systems must know how to map their internal knowledge to the basic concepts of this common ground. It is important especially in the field of e-learning to take different needs of learners into account so that a customisation of features and the content appearance are adapted to the needs of an individual learner. By the time that data is equipped with meaning

and turned into information it is expected that it will be delivered at the right time and context. For the reusable semantics in e-learning systems, researchers will face a challenge of scientific knowledge management which is proposed in terms of a knowledge life cycle [1, 2]. Bringing semantics to e-learning is essential to fulfil the needs of such a flexible system and, furthermore, to provide a seamless framework for a large scale and effective e-learning environment.

III. WEB SERVICES AND SEMANTIC WEB TECHNOLOGIES

A. Web Services

Web Services are a way of creating applications that allows integrating different applications on the Web into a unified service. A Web Service requires three basic components: a messaging service, an interface description language, and a registration service. Educational services can be categorised as four services: learning, assessment, references and collaboration. Currently Web Services with educational purposes are being developed. The e-learning framework is an effort of not only JISC, but also DEST (Australia), Industry Canada, E-Learning Framework (ELF) and others to start putting together a 'palette' of e-learning features that services can be used for. To develop an e-learning application, one can look at this 'palette', select the services of interest (either to consume or provide), download toolkits provided by other developers to help integrate the service, and then incorporate them into their application. The notion of Web services offers a way to make components mobile and accessible within the huge amount of Web information and applications.

B. Semantic Web

The Semantic Web is the emerging landscape of new Web technologies aiming at Web-based information and services

which would be machine understandable, and also easy to grasp for humans. The Semantic Web can be said to be, from a constructivist's point of view, all about authoring, i.e., the ability of annotating web resources with semantic information. This interpretation, or reasoning, requires appropriate knowledge-representation languages, ontologies and support tools [3]. Ontologies can be used in e-learning as a formal means to describe the course providers, courses and people involved in teaching and learning process as well as to define services including registration, authentication, learning content, automated assessment, tracking, discovery services ... Semantic Web technologies provide an effective way to achieve improved adaptation and flexibility for single and group users (e.g. instructors, courseware authors and learners) and new methods and types of courseware compliant. This promising class of Adaptive Web-based Educational Systems forms the basis of the emerging Educational Semantic Web. The study integrates the frameworks proposed by Henze et al. [4] by using several ontologies for describing the features of domains, users, and observations.

Indeed, e-learning is a field which can benefit from Semantic Web technologies. However, more benefits can be gained from expressing individual applications of Semantic Web within a single framework. Accordingly, integration via meaning has been proposed through a semantic portal [5] which can be seen as an entry point to knowledge resources that may be distributed across several locations. Such architecture may be considered within the domain of distributed Grid system.

IV. SEMANTIC GRID TECHNOLOGY

Although some Web technologies are useful for connecting a learning environment to organisational data and processes, the basic architecture behind the WWW is not capable enough to provide

a high degree of automation that supports flexible collaborations and computation on large scale and effective e-learning implementation. Grid computing is an emerging technology that enables large-scale resource sharing and coordinated problem solving within distributed “virtual organisations”. Semantic Grid has been proposed as a merger of both the grid technologies and the Semantic Web [6]. The vision of the Semantic Grid significantly evolves the underlying computer infrastructure and the protocols for interoperability at the data level. By adding meaning (ontologies, annotations and negotiation processes as studied in the Semantic Web and Software Agent paradigms) to the Grid, the Semantic Grid provides not only a general semantic-based computational network infrastructure, but also a rich, seamless collection of intelligent, knowledge-based services for enabling the management and sharing of complex resources and reasoning mechanisms. The Semantic Web can benefit from the Grid in the way that the Grid provides a real context for deploying Semantic Web Services. On the contrary, the metadata for resource descriptions in Grid is typically represented using the technologies of the Semantic Web, such as Resource Description Framework (RDF).

The Semantic Grid for e-learning – the introducing the global computing infrastructure into the field of e-learning – can be defined as a domain virtualisation of the Semantic Grid improved with tools, services, languages, standards and technologies for the education. The Semantic-Grid based E-Learning Framework (SELF) [6] provides a mapping of the key enablers for a realistic E-learning infrastructure to available technologies to establish a well-defined framework for the integration of these technologies so that the goals of effective E-learning can be achieved. Grid technologies are also

applied to provide advanced mechanisms for automatic discovery and binding of new suitable contents and services as well as self-adaptive mechanisms when deploying the learning activities in the collaborative e-learning environment [7]. Experiences from using Grid for mobile e-learning research in [8] illustrated that although the current set of Grid technologies does not fit well with the loosely coupled requirements of mobile e-learning, mobile e-learning can benefit from it.

IV. CONCLUSION AND FUTURE WORKS

The Semantic Web/Grid vision propagates an image of the e-learning infrastructure having resources on the Grid semantically enriched and linked for more high degree of easy-to-use and seamless automation enabling flexible collaboration and computation on a global scale [2]. Bringing semantics to learning content and service is aimed to enable large-scale collaboration of e-learning activities over the Grid infrastructure. There has been increasing recognition that Semantic Web technologies are useful not only on the Grid infrastructure but also within it, providing the means to describe resources and services and compose them in virtual organisations. Clear benefits for educational community can come from a well defined Grid based strategy.

In this paper, I have discussed of what the Semantic Web and the Semantic Grid bring to e-learning. The future research will be on building an abstract unit of learning model interacting with a Grid system able to provide appropriate learning objects and services for the adaptive features with respect to the individual, the group and the instructor’s own perception.. The learning model should be aim at supporting the e-learning workflow and collaboration. Such a work enquires to collect real requirements from users, and to collect use cases as well

as to more fully understand the process of collaboration in e-learning.

TÀI LIỆU THAM KHẢO

[1] Tao, F., Millard, D., Woukeu, A., Davis, H., "Semantic Grid Based e-Learning Using the Knowledge Life Cycle," *icalt*, pp. 954-955, Fifth IEEE International Conference on Advanced Learning Technologies (ICALT'05), 2005.

[2] De Roure, D., Jennings, N.R. and Shadbolt, N. R., "The Semantic Grid: A Future e-Science Infrastructure," Technical Report of the National e-Science Centre, UkeS-2002-02, 2001.

[3] Mizoguchi, R., "Ontology Engineering Environments," in *Handbook on Ontologies*, Berlin: Springer, 275-298, 2004.

[4] Henze, N., Dolog, P., & Nejd, W., "Reasoning and Ontologies for Personalized E-Learning in the Semantic Web," *Educational Technology & Society*, 7 (4), 82-97, 2004.

[5] Moreale, E., & Vargas-Vera, M., "Semantic Services in e-Learning: an Argumentation Case Study," *Educational Technology & Society*, 7 (4), 112-128, 2004.

[6] Abbas, Z., Umer, M., McClatchey, R., Ali, A., Ahmad, F., "A Semantic Grid-based E-Learning Framework (SELF)," *CLAG+Grid.edu*, Cardiff, UK, 2005.

[7] European Learning Grid Infrastructure Project

Homepage: <http://www.elegi.org/> [last accessed 30/12/05]

[8] Millard, D. E., Woukeu, A., Tao, F. and Davis, H. C., "The Potential of Grid for Mobile e-Learning," in *Proc. Workshop on Ubiquitous Computing and e-Research*, National e-Science Centre, May 2005.

[9] Aroyo, L., & Dicheva, D., "The New Challenges for E-learning: The Educational Semantic Web," *Educational Technology & Society*, 7 (4), 59-69, 2004.