Corner Stones of Semantic Interoperability Demonstrated in a Smart Space for Learning

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ABSTRACT

This paper summarizes the demonstration of a semantic network of interoperable educational systems. Based on a standardized query API, plus a common schema for querying and results presentation as well as the query language QEL, the ELENA project has connected several educational nodes, ranging from online bookstores to course databases. The strength of the approach resides in a sufficiently powerful API called Simple Query Interface (SQI) that provides method support for asynchronous and synchronous queries. The underlying common schema is specifically designed to the needs of an educational network of training measures while reusing standardized concepts from IEEE LOM and Dublin Core at the same time. Mediating tools bringing the worlds of RDF, XML and relational databases constitute another critical success factor of this demo.

Categories and Subject Descriptors

H.3.3 [Information Storage and Retrieval]: Information Search and Retrieval - Search process

General Terms

Management, Design, Standardization, Languages

Keywords

RDF, XML, Querying, E-learning, Interoperability

1. INTRODUCTION

The Web puts a huge number of learning resources within reach of anyone with Internet access. However, many valuable resources are difficult to find in an efficient manner, because valuable resources are hidden in the closed and proprietary worlds of learning (content) management systems, streaming media servers and online collaboration tools.

In order to achieve interoperability among heterogeneous educational systems, the ELENA project has implemented a novel infrastructure and software solution using various Semantic Web technologies. This infrastructure is built on the following corner stones:

1. A common API for querying, called Simple Query Interface (SQI) with a web-service based instantiation of the API,

2. A common semantic model for querying and results format presentation, instantiated in XML and RDF.

3. Re-usable components for integrating existing systems with a minimum effort. We have developed such components for RDF repositories, XML documents (databases) and relational databases

The goal of this infrastructure is the realization of a Smart Space for Learning that allows us to integrate heterogeneous educational nodes in a semantic network and provide 'smart' access technology for it [2]. In combination with process-support for learning goal definition, personalized search, and feedback tools the educational semantic network (the 'space') plays a crucial role for supporting corporate personnel development. The broad variety of learning resource types available allows us to significantly widen the scope of learning resource choices. Hereby, potential learners are not stuck with the course offerings of a particular provider or are restricted to a particular learning format, for example, a costly classroom-based course, but can expand their search to several types of learning formats, for example, books from Amazon, and providers. One driving force for the development of this feature has been an extensive requirements analyze, which has lead to the need of integrating resources of heterogeneous formats, in educational search tools [1].
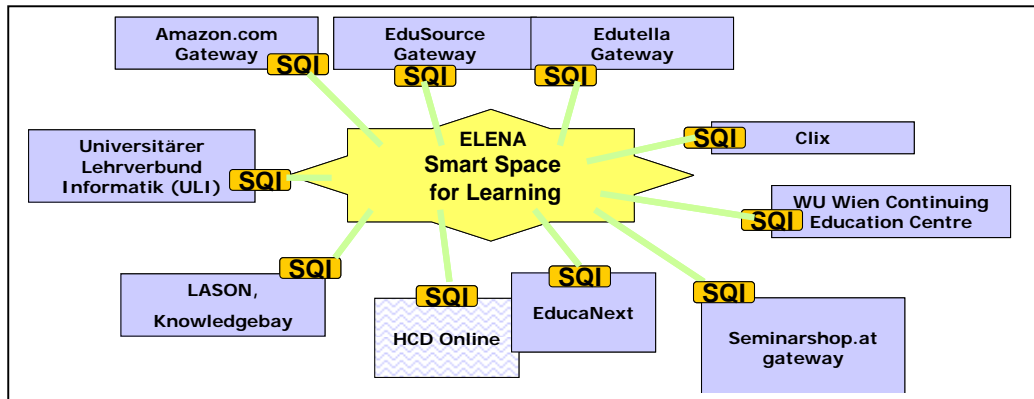
Figure 1. Nodes on the ELENA Smart Spaces for Learning

2. BUILDING INTEROPERABILITY

An open, collaborative effort, under the auspices of the CEN/ISSS Learning Technologies Workshop, has resulted in the design of the SQI [3]. The overall objective of these activities is to achieve interoperability between learning object repositories, in order to build up a global network of learning object repositories. In addition to ELENA, the IST-funded PROLEARN Network of Excellence is coordinating some of the practical experimentation with these specifications.

The SQI is part of a Learning Object Repository Interoperability (LORI) Framework. LORI is a layered integration architecture, which defines services to achieve interoperability among learning repositories. These services include core services, for example authentication service, session management service and application services like query management or provision services.

SQI is neutral in terms of query language and semantic model used. The semantic model instantiated in the ELENA Smart Space for Learning distinguishes is based on a particular use case in the context of personnel development processes (see ELENA Interoperability Case Study at the SQI web site for details). The use case has lead to concrete queries that ELENA Smart Space for Learning is designed to support.

3. IMPLEMENTED SEMANTIC NETWORK

For all connected systems we created a mapping to the common schema, which enabled us to issue queries against this schema. We expressed the common schema in RDF and used QEL as a query language.

So far, we have connected several systems to our network that can all be accessed by the personnel development portal HCD Online (see Figure 1). For all systems we had to create a mapping to establish the connection between the local metadata representation and our common schema. This was a challenging task, since these systems not only use different local schemas, but also differ how they represent the metadata.

The ULI Campus stores the metadata in RDF files. Academic educational brokerage systems (EducaNext) and commercial learning (content) management systems (CLIX) or course databases (course catalog of the Continuing Education Centre of WU Wien) often store the metadata in relational databases. They again used DBMSs from different vendors, in our case Oracle, Postgresql, MySQL, and Firebird.. Other systems store their metadata in XML files (Metzingen Continuing Education Institute, EduSource educational network of Canada). We developed a query translation technique, so we could translate the QEL queries into a corresponding XQuery. Using our query translation technique we were able to integrate also other systems (LASON, Knowledgebay) using native XML database (eXist). We needed a different method to integrate the media store of Amazon. Amazon offers a Web Services interface, so we had access to their rich metadata, stored in a proprietary format. We developed a query translation of QEL queries into Amazon search objects, which enabled a smooth integration of the available metadata.

We faced different kinds of challenges when integrating entire P2P networks (Edutella). While other systems usually give synchronous answers to queries, in case of Edutella we had to handle asynchronous answers from the network.

4. TECHNICAL REQUIREMENTS

We demonstrate an application running at our web server therefore the only requirement for the demo is Internet connection. The software is built mostly from open-source components.

5. ACKNOWLEDGMENTS

6. REFERENCES

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