EAGLE – Local Government Learning Platform

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Abstract. This paper presents our approach to designing and developing the EAGLE (EnhAnced Government Learning) platform and its Open Data and Linked Data features. The aim of the platform is for local governments in rural areas to adopt Technology-Enhanced Learning (TEL) solutions as an effective way to keep up with the fast pace of innovation, which is affecting public administration in the EU. EAGLE is based on open source tools, such as Apache Marmotta (Linked Data Platform) and Apache Stanbol (semantic enhancement engine). It uses Linked Data as an integration technology. We present three steps to our approach: (i) data integration from various government and/or learning data sources, (ii) semantic data enhancement, and (iii) publishing the enhanced data as Linked Data. These steps lead towards creation and deployment of services tailored to support extensive learning for public administration in rural areas, employing assessment technologies, change management methods, and cross-device learning strategies.

Keywords: Open Data, Linked Data, Technology Enhanced Learning, local government learning, learning platform, semantic enhancement

1 Introduction

A new transformational trend in education, known as "open education", relies on (i) novel models for delivering learning content such as Open Educational Resources (OER) e.g. through Massive Open Online Courses (MOOC), etc., (ii) the use of state-of-the-art technologies for sharing, publishing and connecting information globally, (iii) massive adoption of novel online and distance learning models in schools, but also by leading business and government institutions. Public administration (PA) typically has to cope with a large amount of heterogeneous data, which is either distributed by various users and topics, or triggered by changes in current regulations and laws. Today, many rural regions and their local governments are greatly affected by globalization and economic developments all requiring new policies addressing agricultural, environmental, or tourism concerns (e.g. services such as supply of drinking water, renewable energy, biofuels, electricity production from biomass, bio-diversity in agriculture, rural tourism, transportation, etc.)

Although learning in PA is a fairly new field, several different approaches have already been tested; for example, using professional learning profiles [1], training initiatives organised by regional competence centres [2], training in the context of

"management by objectives" [3], training in local government (e.g. with *urban planners* that help local government decide how to solve various problems).

In this paper, we present our approach to design and develop the EAGLE (EnhAnced Government LEarning) learning platform. Section 2 presents related work in Open Data and Linked Data technologies for data integration in the field of open education. In addition, it discusses our motivation to develop a learning platform to foster adoption of trends in local (rural) government policies. Section 3 shows the architecture of the EAGLE platform. Section 4 presents our approach to integrate, enhance and publish governmental data for educational purposes. The EAGLE platform encourages the development of novel educational services, which need to be tailored to specific government learning needs. Some of these services are mentioned in Section 5, although the full set of EAGLE learning services is outside of the scope of this paper. Section 5 presents next steps and concludes the paper.

2   Related Work and Motivation of the EAGLE Approach

Related work. Linked Data Platform 1.0, commonly abbreviated as LDP [4], is a recent W3C technology that describes the use of HTTP for accessing, updating, creating and deleting resources from servers, which expose their resources as Linked Data (LD). It provides clarifications and extensions of the rules of LD [5][6]. It uses standard HTTP and RDF techniques to construct clients and servers that create, read, and write Linked Data Platform Resources (LDPR). The LDP specification defines a special type of LDPR Container (LDPC), which is used for building application models that involve collections of resources. Resources can be added to containers by using standard HTTP operations, e.g. POST. Apache Marmotta[1] is one of the early implementations of LDP technology and has been chosen as one of the basic technologies for EAGLE.

The W3C's Government Linked Data (GLD) Working Group[2] provides standards and information, which enable governments around the world to publish their data as LD. Another W3C eGovernment Interest Group is meant for broad community discussion of governmental use on the Web. One of the best LD practices in government so far is the governmental data portal in the UK[3]. Recently, Google and Microsoft have started to employ LD as an integral part of their offerings [7]. Educational institutions also adopted LD approach: e.g. mEducator – Linked Educational Resources[4] focuses on publicly available educational resources. Another example is the EU project EUCLID with the aim to develop a comprehensive educational curriculum supported by multimodal learning materials and highly visible eLearning distribution channels (e.g. Apple and Android tablets, Amazon Kindles, standard web browsers). Similarly, the LinkedUp project[5] collects educational LD in a

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[1] Apache Marmotta website: https://marmotta.apache.org/
[2] W3C GLD Working Group: http://www.w3.org/2011/gld/charter
[3] Governmental data portal in the UK: http://data.gov.uk/
[4] mEducator website: http://www.meducator.net/
[5] LinkedUp project website: (www.linkedup-project.eu/

global data catalogue, providing access to those data and aligning their vocabularies in a way that they can be used and queried jointly.

Motivation of our work. To understand the main directions of learning challenges in local government, we have conducted an interview-based pre-study in Luxembourg, Montenegro, Germany, Austria, and Ireland in 2012/13. This pre-study shows that specific regional government knowledge often fails to find its way to the learning materials. Offline courses are not sustainable and updating the material is cumbersome and expensive. Educational training is mostly delivered face-to-face. It cannot respond to short-term learning needs, and requires absence from the workplace over a considerable amount of time. Learning materials are available only to participants. Therefore, our motivation in EAGLE is to apply modern search, presentation and navigation strategies to support education in local government. We reuse public sector datasets developed in EU projects, such as LATC[6], as well as educational datasets, e.g. datasets generated in the OpenScout[7] and the LinkedUp projects.

3 EAGLE Architecture

The aim of the EAGLE architecture [8] is to design and specify a set of components, their services and interfaces, supporting the management of OER in local government. The EAGLE approach follows an open source policy, and reuses existing open source tools and components to build its integrated learning platform. In this paper, we discuss only those components utilising LD technology, such as Apache Stanbol[8], an open source semantic enhancer for lifting of textual information to structured, computable representations, and the Apache Marmotta Linked Data Platform (Fig. 1). Various external local governmental and educational datasets (e.g. educational data from the OpenScout platform, the *moodle* learning platform[9], Légilux[10] governmental portal, and more) need to be transformed into their corresponding RDF models, enabling these resources to be accessible as Linked Data via URIs. Besides information management, the EAGLE learning platform provides data management for OER, which is based on the OpenData CKAN (Comprehensive Knowledge Archive Network), a *de facto* standard software for data catalogues. Also, the OER Registry (Fig. 1) stores content in various standard formats, and allows for metadata harvesting of OER from other CKAN repositories.

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[6] LATC project website: http://latc-project.eu/

[7] OpenScout project website: http://openscout.net/

[8] Apache Stanbol website: https://stanbol.apache.org/

[9] moodle website: https://moodle.org/

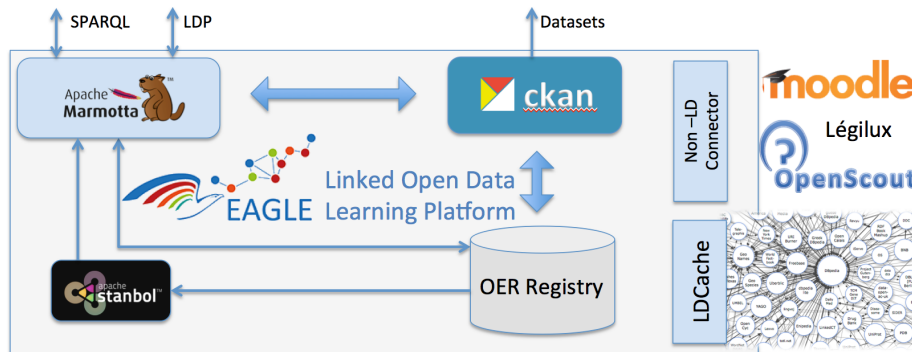[10] Légilux data portal: http://www.legilux.public.lu/

Fig. 1. High-level architecture of the EAGLE Linked Open Data learning platform.
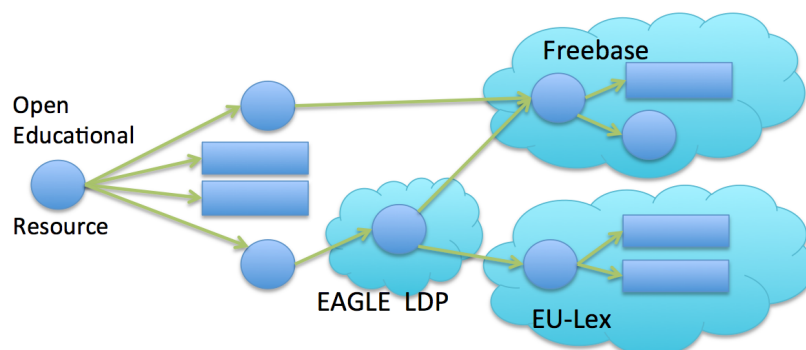
4   Data Integration, Enhancement, and Publishing

The main objective of the EAGLE project is to provide novel search, presentation and navigation services, built on top of the EAGLE platform, supporting TEL in local governments, with end-users from Germany, Ireland, Luxembourg and Montenegro. In this paper, we present the EAGLE information management functionality through exposing learning objects to the Web of Data. For the sake of conciseness, we present only three steps in publishing governmental data:

1.   **Data integration**: We either import structured data from the existing LD sources or transform other non-LD sources into LD-RDF triples via data source adapters
2.   **Data enhancement**: Semantic lifting and content enhancement of the data;
3.   **Data publishing**: The data stored in OER Registry are becoming, either via SPARQL or LDP, available to EAGLE and/or the LD cloud.

   EAGLE Data Integration: EAGLE enables seamless (re)use of data coming from (i) LD resources (e.g. Freebase), and/or (ii) non-LD sources, such as OER repositories (e.g. EUR-Lex[11] with the access to European law). This includes supporting data (e.g. Thesauri) for interlinking OER's with the Web of Data, as well as with open government data for education purposes. Fig. 2 shows the integration aspects of linked resources stored on remote servers in the LD cloud. EAGLE uses the built-in LDCache component of Apache Marmotta, which transparently harvests LD resources and makes them locally available for querying and indexing. LDCache also enables data interlinking with external LD sources, e.g., legal datasets from the LATC project. One of our tasks in EAGLE is to develop dedicated LD *connectors* for non-LD learning platforms, such as moodle and OpenScout, enabling these platforms to be accessible as LD sources via EAGLE. Governmental datasets, e.g. Légilux, will be also integrated and used to support learning processes. EAGLE enforces the usage of standard metadata formats, e.g. IMS Metadata for IEEE 1484.12.1-2002 standard for Learning Object Metadata (LOM)[12].

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[11] EUR-Lex data portal: http://eur-lex.europa.eu/
[12] LOM website: http://ltsc.ieee.org/wg12/20020612-Final-LOM-Draft.html

Fig. 2. EAGLE OER Data Integration.

EAGLE Data Enhancement: To achieve data harvesting and interlinking of data from external sources, we perform semantic interlinking by using the Apache Stanbol semantic enhancement engine. Apache Stanbol allows for a series of extractors and annotators to be used in a fashion like UNIX-pipes, based on specific content features, e.g. MIME type or language. In such a way, various OERs, either retrieved from external sources and/or stored in EAGLE OER Registry, will be annotated and interlinked with concepts from the Web of Data [9]. To improve OER metadata quality, we will build learning services to provide learners with additional extraction and annotation mechanisms.

EAGLE Data Publication: Besides the Apache Stanbol enhancement engine, the EAGLE learning platform incorporates Apache Marmotta, a LDP compliant platform [9]. Apache Marmotta provides: (i) read-write functionality over LD, (ii) exchangeable RDF triple stores, supporting transactions, versioning and rule-based reasoning, (iii) SPARQL and Linked Data Path (LDPath)-based querying, (iv) transparent Linked Data Caching mechanisms (e.g. LDCache component that enables data interlinking with external LD sources, including non-RDF sources), and (v) basic security mechanisms. In that way, the EAGLE platform inherits the LDP capabilities of Apache Marmotta, and allows for the publication of all managed OERs on behalf of their resource URI, or by means of SPARQL queries. For further reuse, the data published via EAGLE will follow the IMS and LOM standards.

5   Conclusions and Future Work

Linked Data technology has the potential to solve some important problems that have frustrated the IT industry for many years. This requires a much richer body of knowledge to be communicated on how to exploit these technologies in various organizational habitats. It also requires that present gaps in the LD standards, as well as some legal barriers to commercialization of LD (i.e. gaps in a range from the missing licensing information to restrictive licenses prohibiting commercial usage of LD) need to be properly addressed.

The overall implications of exposing various datasets related to the local governmental learning to the Web of Data are significant, offering benefits such as:

collaborative creation and sharing of local governmental knowledge on the Web of Data; semantically and LD-based enhanced learning opportunities; improved interactivity due to concept-based navigation and search capabilities; improved findability of data when all alternative terms, synonyms, acronyms or jargon can be used to find or match ideas or concepts, etc.

One of the major technical challenges for EAGLE is to provide a smooth integration of the existing open source platforms, tools and services into the EAGLE Open Data and Linked Data learning platform. In that context, one of the first steps is the enhancement of the OER metadata scheme to support CKAN for the *OER Registry* component (Fig. 1). In parallel the LD connectors to existing non-LD OER repositories will be developed to enable data reuse within the EAGLE platform. In addition, an OER ontology focusing on public administration will be developed, considering the current OER-CC ontology presented in [10].

The EAGLE Open Source and Linked Data local governmental learning platform follows the emerging W3C LDP recommendations, and will be the first LD platform for OER-based learning in public administration in the EU.

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