Semantic ontologies for a social network of competencies

D. Taibi, G. Fulantelli, M. Gentile and M. Allegra

Italian National Research Council - Institute for Education Technology

Key words: Social networks, Semantic Web, learner competencies

Abstract:

In this paper we propose the integration of the FOAF ontology, used to model people and their personal contacts, with semantic ontologies related to student competencies. In particular, the use of ontologies and other semantic web technologies allows us to create relations between the evolution of student educational experiences and their social network. For this to happen, we integrate FOAF with the IMS Learning Information Package model in order to create a new Web 2.0 learning environment.

1 Semantic ontologies for a social network of competencies

The Information Society dramatically increases the opportunities for knowledge acquisition, participation in social networks, creation of communities of practice and collaborative content sharing. The content sharing system Connexions, the user built encyclopedia Wikipedia, the learning object management system FreeLOms [1] are example in which users share their competencies to create new knowledge. As stated by S. Downes [2] “the emergence of the Web 2.0 is not a technological revolution, it is a social revolution”.

There are also some critiques for the unstructured content organization in the Web 2.0 world. Due to the heterogeneity of the nature of social contribution sharing models, searching, connecting and retrieving these kinds of contents has become more complex. Currently Web 2.0 applications are following an unstructured approach in which the meanings of published contents is often self-assigned by users through tagging activities.

The semantic web technologies provide standards and models which could be useful for creating a network of data, with unified models that can represent data from different sources appropriately.

Adding semantics to the web provides easier search mechanisms, supports the reuse of contents and creates more connections between different types of contents. Moreover, the semantic web offers a generic infrastructure to interchange, integrate and reuse structural data, and this can help in overcoming the limits of Web 2.0 platforms.

The unification of semantic web technologies and social paradigms gives rise to "Social Semantic Information Spaces" in which information is socially created and managed, as well as being interconnected and available in a machine understandable format, promoting new methodologies to discover information present on the web [3].

In this perspective, the concept of networked learning is drastically changing. Students interact and collaborate in new ways thus leading to the definition of new learning environments; they are different from traditional on line learning environments, since learning contexts and social spaces tend to be more and more integrated. In these less structured environments, in which the interactions with other users become increasingly significant, adding and making use of information concerning the competencies of the learners become an opportunity. Consequently, the use of software to model learner profiles and to manage them in a semantic way appears ever more important.
The semantic web provides a technological substrate to set up the base for creating ontological systems able to model competencies in the Web 2.0 informal educational environments. In this paper we consider the problems connected to the description of competencies in informal learning environments within social networks mediated by technologies. In particular, we propose the integration of the FOAF (Friend Of A Friend) ontology, which is used to model people and their personal contacts, with a semantic ontology related to student competencies. The use of ontologies and of the related semantic web technologies allows us to create relationships between the students’ ongoing educational experiences and the evolution of their social network. For this to happen, we integrate the FOAF ontology with the IMS Learning Information Package model, thus supporting the creation of a new Web 2.0 learning environment based on social networks and competencies.

2 Learner model and competencies standards

As reported in literature there are various definitions of learning competency; in our study we consider the definition of Bloom and Wallace. They started from the concepts of Knowledge, Skills, Abilities, and Other Characteristics (indicated with KASOC acronym) and consider the competency as “A specific, identifiable, definable, and measurable knowledge, skill, ability and/or other deployment-related characteristic (e.g. attitude, behavior, physical ability) which a human resource may possess and which is necessary for, or material to, the performance of an activity within a specific business context”. We extend this concept taking into consideration that competencies are strictly related to the abilities acquired across the lifelong learning experiences.

The importance to describe the person’s education and career development both at university and companies level have led to the definition of various standards, supported by different worldwide organizations. Among them the most relevant are the following:

- IEEE PAPI is a specification developed by the IEEE Learning Technology Standards Committee Working Group designed to describe learner information for communication among cooperating systems [4]. This standard stores descriptive information regarding six main categories connected to the following types of information: personal, relation, security, preference, performance and portfolio. Personal information is private information related to the learner such as name, surname, address and so on. Relations information represents learner’s relationship to teachers, tutors and other students. Security information contains passwords, and other private credential. Preference information shows information related to human-computer interactions. Performance information is connected to the learner’s experience development. Finally, Portfolio information describes learner’s works useful to define abilities and achievements.

- IMS Learning Information Package, defines a data model focused on the description of learners’ experiences, goals and accomplishments [5]. LIP is divided into eleven categories and includes information about: educational achievement from school through to college, and other information related to professional development activities undertaken, personal achievement, relevant work experience, qualifications and education history.

To define learner competencies, these standards are related to other data models specialized in the description of competencies. Even in this field there is not a common adopted standard but there are different models with specific characteristics. The most relevant models are summarized in the following list:

- IMS RDCEO (Reusable Definitions of Competence and Educational Objective) is a data model designed to define, describe, reference and exchange competencies and learning
objectives. This is an extensible model based on XML. The undertaken data model supports the definition of competencies both in structured and unstructured mode. The structured mode uses a collection of different types of Statements in order to define Condition, Action, Standard, Outcome and Criteria related to competencies. The unstructured mode, instead, is based on a human-readable format description.

− IEEE RCD (Reusable Competency Definitions) is based on the IMS RDCEO, previously presented. This standard has been defined by the IEEE Learning Technology Standards Committee and consists of a data model for describing, referencing and sharing competency definitions. The RCD standard provides a formal way of representing the key characteristics of a competency, independently of the context. The main aim of this standard is the interoperability of systems based on competencies by means of a standardized common model that defines competencies.

− HR-XML Competency Schema [6] is a set of specifications developed with the aim of simplify the management of the different aspects of human resources. This specification uses two different XML schema to manage competencies: CompetencyType schema and Competencies schema. The CompetencyType is based on two main concepts: CompetencyId, SpecifiedCompetencyReferenceType. The first is used to create a reference to a single competency or a group of competencies within a specialized taxonomy. The Competencies schema is designed to support an easy and flexible management of the competencies. This standard does not define a taxonomy of competencies either tools to create an explicit mapping between elements coming from different taxonomies.

3 Using semantic web technologies to describe competencies in Web 2.0 environment

The wide availability of standards to describe competencies introduces some interoperability problems amongst systems dealing with heterogeneous learner profiles. In particular, there are some issues in considering the equivalences and overlapping between the concepts expressed in different competencies data model.

Semantic web technologies offer a generic infrastructure to interchange, integrate and reuse structural data that can be useful to overcome these limits. Adding semantics to the web would enable this kind of problem to be solved, by providing easier search mechanisms, supporting the reuse of contents and creating more connections between different types of contents. Moreover, the use of ontologies is useful to structure and elaborate information. Ontologies represent entity-relationship models concerning a specific knowledge or practice domain. A typical web ontology contains the definition of classes, objects and their relationships, and a set of deduction rules that give inferential power about the concepts.

Through the ontologies, the semantic web provides the basis for enriching the resources description with a well defined meaning and in a comprehensible format which can be elaborated by software applications.

The approach proposed in this work is based on the creation of a specifically designed ontology that extends the FOAF ontology [8][9], in order to describe the domain of competencies as defined by the IMS LIP specification. For this to happen we analyze the FOAF ontology and its relationships with the IMS LIP specification, in order to highlight equivalences and overlapping in concept definition.

As defined in the specification [5], the IMS Learner Information Package (LIP) core data structures are the following:

− Identification: containing learner biographic data.
- Goal: holds information on learners’ career and objectives.
  - Qualifications, Certifications and Licenses (qcl): reports qualifications, certifications and licenses released by recognized authorities;
  - Activity: contains learning-related activity in any state of completion. This section represents formal and informal education, training, work experience and so on.
  - Transcript: it is used to provide an institutionally-based summary of academic achievement.
  - Interest: describes hobbies and recreational activities;
  - Competency: skills, knowledge, and abilities acquired by the learners.
  - Affiliation: lists the membership of the learner in professional organizations.
  - Accessibility: reports learner information about language capabilities, disabilities and learning preferences including learning style, physical and technological preferences.
  - Securitykey: contains passwords and security keys assigned to the learner to access learner information systems and services;
  - Relationship: describes the relationships between the core components.

The personal profile information in FOAF are divided in the following five categories:
- **FOAF basic**: consider general data about a person such as: name, surname, homepage, title, nick, and so on.
- **Personal Info**: contains more personal information related to the interests, the publications, online blog and relationships of the learner.
- **Online Account**: is related to the account information owned by the person, for example icq, msn, aim, jabber, yahoo chat accounts.
- **Projects and Groups**: maintains information about projects, groups, organizations in which the person is involved.
- **Documents and Images**: references to personal documents and images are contained in this section.

**Figure 1: Relationship between FOAF and IMS Learner Information Package**

This figure outlines how the concepts of the standard LIP can be bound to the concepts of FOAF. In particular, both FOAF and LIP standards provide the management of a set of information related to the user profile. Moreover, the LIP standard can be linked to other models to define competencies and to organize them in a structured way.
By representing these connections in terms of ontological relationships, it is possible to define a social network which includes the description of the competencies of its participants. In particular, the approach proposed is based on the integration of the FOAF ontology with an ad-hoc ontology designed to describe the domain of competencies as defined by the IMS LIP.

4 Closing remarks

The solution proposed in this paper open up several use scenarios. Rather than describing some of them, in this section we illustrate a very general scenario at a high level of abstraction, that can be adapted to more specific situations. The scenario focuses on the different learning solutions between a user participating in a typical social network and the same user involved in a network which integrates the approach illustrated in this paper.

In a typical social network, the learning process is based on the educational resources found on the Internet and filtered through traditional mechanism (such as search engines), and on collaboration and interaction with other users of the same network. Depending on the level of structuring of the communication and on the type of educational resources accessed by the user, we can refer to more formal or informal learning approaches. Specifically to the informal learning component which contributes to the whole knowledge building process, the role played by communication with other users is central. In turn, this implies that the competencies and learning goals of other users are key-elements for the learning process. In a social network environment backed by the solution proposed in this paper, the system can highlight people in the network who share common learning goals and own comparable competencies, and also resources, groups and activities related to them. In such a way, the communication threads result more profitable for the learning process, guaranteeing more effective learning outcomes. In addition, information brokering and filtering occurs in a collaborative way, further improving the whole learning process.

References:

Author(s):

Davide, Taibi
Italian National Research Council
Institute for Educational Technologies
Via Ugo La Malfa 153 - 90146 Palermo - ITALY
e-mail: davide.taibi@itd.cnr.it

Giovanni, Fulantelli
Italian National Research Council
Institute for Educational Technologies
Via Ugo La Malfa 153 - 90146 Palermo - ITALY
e-mail: giovanni.fulanelli@itd.cnr.it

Manuel, Gentile
Italian National Research Council
Institute for Educational Technologies
Via Ugo La Malfa 153 - 90146 Palermo - ITALY
e-mail: manuel.gentile@itd.cnr.it

Mario, Allegra
Italian National Research Council
Institute for Educational Technologies
Via Ugo La Malfa 153 - 90146 Palermo - ITALY
e-mail: mario.allegra@itd.cnr.it