ePlanning: an Ontology-based System for Building Individualized Education Plans for Students with Special Educational Needs

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The *Individualized Education Plan* (*IEP*) is a document that defines academic/life goals for a pupil with special educational needs. The IEP is built specifically for the pupil, and it is the result of a collaborative activity that involves the school special education team, the parents, other relevant educational stakeholders, as well as, whenever possible, the student. In details, an IEP specifies the student academic/life goals and the methods/kind of educational intervention to obtain these goals (long, medium, short term range). The IEP also identifies activities, supports and services that students need for being successful in their school activities in the perspective of the “special normality” principles, as required by the Italian Law 104/92 for students certificated for a disability. Besides the wide employment, in the last years, of IEPs in several Italian schools of any educational level (kindergarten, primary school, middle school, high school), the development of a IEP for a given pupil is a manual, complex and time-consuming activity.

To support and facilitate the building of the IEP, we developed a web-based decision support system, called *ePlanning*: users input relevant aspects of the profile of a pupil (e.g., age, diagnosis, observations) into the system, and based on this content the system guides the users in defining the more appropriate academic/life goals for the pupil, suggesting also activities and educational material that may help in achieving these goals. Semantic Web (SW) technology plays a key role in ePlanning, as well as in its development.

First, ePlanning (see Fig.1) is an *ontology-based application*, i.e., the content the system uses to support the construction of an IEP is encoded in an *OWL 2 ontology*, which formalizes: (i) *processes*, that represent functional abilities; (ii) relevant *features* of pupil profiles (e.g., age, school grade, a diagnosis in terms of a ICD[1] or ICF[2] code) and their relation with functional abilities; (iii) proposal of *goals* that can be set in the presence of an impairment of some functional abilities; and, (iv) *activities* and *educational materials* that

[1] http://www.who.int/classifications/icd/en/
[2] http://www.who.int/classifications/icf/en/

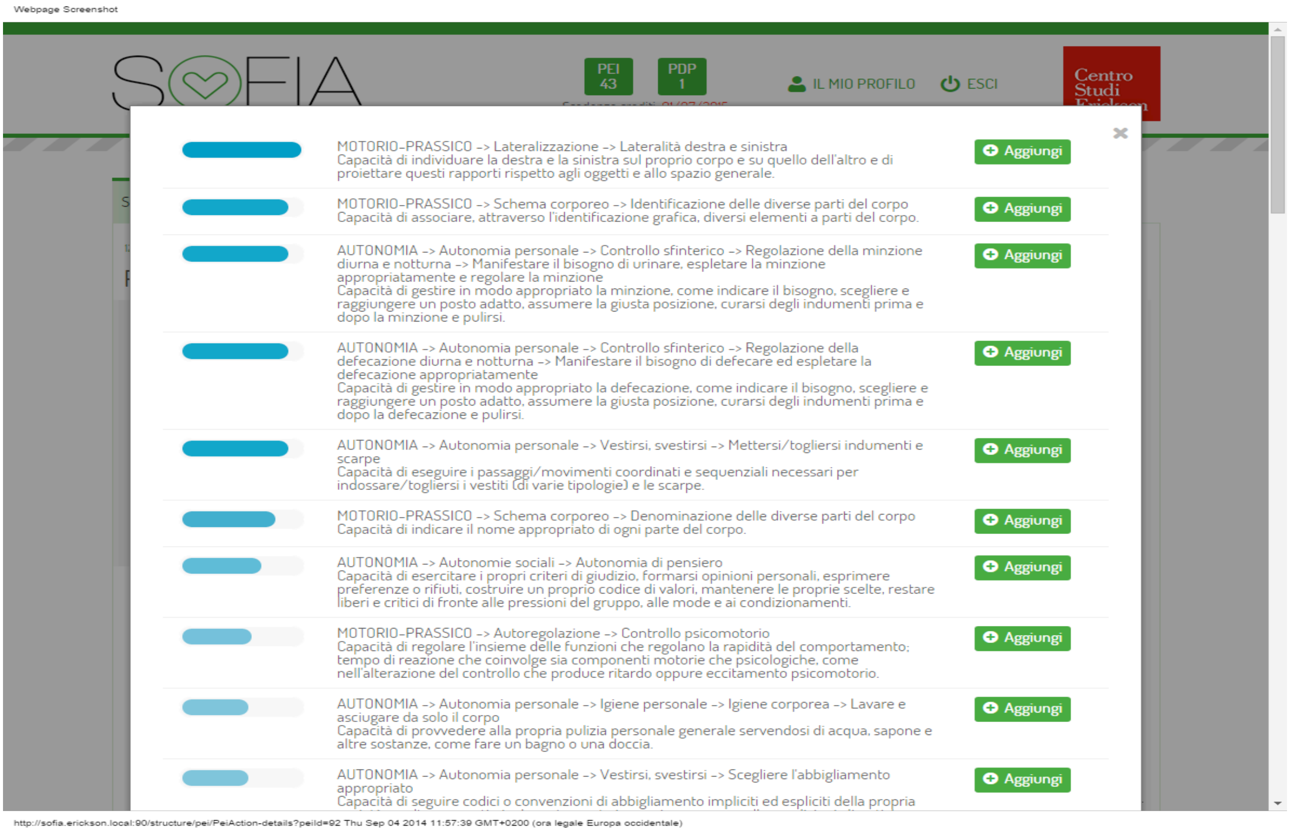

Fig. 1 - Screenshot of the ePlanning application

can be used to achieve the proposed goals. The system iteratively accesses the ontology content via querying, also exploiting inferred content materialized via OWL-DL reasoning.

An important example of query is the one that returns all the information of a given functional ability. Given the Uniform Resource Identifier (URI) of a functional ability the system connects to the data store containing the ontology, it performs the query with SPARQL language and retrieves all the relevant information. Such information are the parent (the URI of) and the children of that functional ability (according to the taxonomy of processes and sub-processes), its label, description and clarifying questions in natural language, the sex compatible to that functional ability, some possible ICF or ICD10 codes, an order and a weight representing its relevance in the taxonomy. Another query is the one that, given the URI of a process representing a functional ability, returns the information of its sub-processes. First the query retrieves all the sub-processes, and then the query above is executed for extracting the information of every single functional ability. The power of the semantic technologies is that the URIs of the individuals in the ontology univocally identifies them, so potentially (if the ontology would be public) a single functional ability could be retrieved by whatever application in the world.

The architecture of the ePlanning system is divided into three tiers: *the Presentation Tier*, the *Business Logic Tier* and the *Data Tier*. The Presentation Tier is the interface the user interacts with for building the IEP. It is the application oriented layer and it communicates its requests to the Business Logic Tier. The requests are handled by this latter layer through methods exposed by a web service implemented with a REST (REpresentational State Transfer) architecture. Every method semantically queries the ontology from the Data Tier in order to satisfy the application logic. The Data Tier physically retrieves the data from the ontology with the logical inferences already computed. The ontology is stored in an openRDF Sesame triple store.

Second, to favour the construction of a high-quality ontology, a heterogeneous team of (~20) users having complementary competencies and skill was involved in its development [1]:

- *Psychologists and Educators:* to define the taxonomy of processes and sub-processes (more than 400) referring to different functioning areas of the students: Cognitive – neuropsychological; Communication – language; Affective – relational; Motor skills; Sensory; Autonomy (personal and social); Learning.
- *Teachers* (from: kindergarten, primary school, middle school, high school): to define goals (long, medium, short term range) and related activities established on the base of the level of impairment (more than 9000).
- *Knowledge Engineers:* to provide the modelling expertise to properly model the rich content to be represented.
- *Application Engineers:* to bring in the application perspective, in particular for the requirements of application-specific content to be modelled in the ontology.

The modelling was performed with a customized version of MoKI [2],[3] the Modelling Wiki, that was extensively used by the modellers: in over a one-year modelling period, we tracked more than 6500 editing operations from 13 distinct users.

ePlanning will be released in September 2014 as a commercial tool[4] edited by Edizioni Centro Studi Erickson,[5] having as target audience the schools of all the national territory.

In this talk we will discuss the experience of adopting Semantic Web technology in a key product of the enterprise, including a report of the lessons learned (i) in collaboratively building an ontology (a first experience for the enterprise and most of the users involved in

[3] http://moki.fbk.eu
[4] commercially released as “SOFIA”
[5] an Italian Small-Medium Enterprise in the Publishing Domain

the modelling activities) in a concrete and multidisciplinary context, as well as (ii) in developing an ontology-based decision support system.

In particular, regarding point (i), we will report, for example, the importance of having a "flexible", ad-hoc, on-line, and collaborative modelling tool as MoKI, that allowed for avoiding the proliferation of "latest" versions of documents by domain experts, familiar with spreadsheet before this experience, and consequently considerably reducing human effort. Furthermore, other two important aspects emerged during the modelling phase: the importance of early deploying the application ontology in its corresponding system (even if under development) already during the modelling activities, in order to favour the improvement of the ontology quality and the early detection of modelling mistakes and assumptions; and finally, the importance of adopting an hybrid ontological representation (i.e. representing each core element both as a class and as an individual) to ensure a multipurpose ontology, to be used as a traditional classification ontology on the one hand, and as the main data component of an application system on the other hand.

Regarding point (ii) we will report the importance of hiding the difficulties of retrieving semantic data from data store (e.g., handling URIs and implementing SPARQL queries) by exposing pre-canned methods through web service. The web service was implemented by the knowledge engineers, while the application engineers concentrated only on the application perspective without any efforts of interfacing with semantic data and without altering their usual development processes. This work methodology has allowed for a rapid development of ePlanning system.

These and other lessons learned may be beneficial for similar modelling initiatives regarding the development of ontology-based application in practical case.

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