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RSS-based e-learning recommendations exploiting fuzzy FCA for Knowledge Modeling

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ABSTRACT

Nowadays, Web 2.0 focuses on user generated content, data sharing and collaboration activities. Formats like Really Simple Syndication (RSS) provide structured Web information, display changes in summary form and stay updated about news headlines of interest. This trend has also affected the e-learning domain, where RSS feeds demand for dynamic learning activities, enabling learners and teachers to access to new blog posts, to keep track of new shared media, to consult Learning Objects which meet their needs.

This paper presents an approach to enrich personalized e-learning experiences with user-generated content, through a contextualized RSS-feeds fruition. The synergic exploitation of Knowledge Modeling and Formal Concept Analysis techniques enables the design and development of a system that supports learners in their learning activities by collecting, conceptualizing, classifying and providing updated information on specific topics coming from relevant information sources. An agent-based layer supervises the extraction and filtering of RSS feeds whose topics cover a specific educational domain.

1. Introduction

Typically, e-learning represents an application of Information Technologies (and in particular Internet Technologies) for the development of learning processes, enabling the production and the fruition of educational content at anytime and from anywhere. Recently, in an alternative definition, the "e-learning" is an individual or collaborative group activity where both synchronous and asynchronous communication may be employed. In this context, the diversity of students' background is one of the most important issues. Enrolled students come from many different linguistic, cultural, and academic backgrounds, hence the conventional e-course materials cannot always meet different students' needs. Thus, it is evident that *one curriculum for all* is no longer suitable for the e-learning environments. The aforementioned statement suggests that a great expectation for personalized e-learning is raising [8].

Nowadays, the Semantic Web technologies are considered the most promising solutions to effectively organize and manage available e-learning resources, meeting the peculiar requirements of both teachers and students. In [13], an overview of the Semantic Web-based education field is presented. The focus is on the ontology-based e-learning systems and the personalization within e-learning applications. This study emphasizes that the automation of ontology development processes, the automation of content annotation, the development of intelligent pedagogical agents and adequate techniques for personalization are some of the challenges to overcome. In particular, in [10], the requirement of personalization for e-learning systems is defined as the capability to provide to each learner the content that better meets his needs. Furthermore, in the e-learning domain, an increasing role is given to the Knowledge Modeling through metadata-based standards [9], although problems of incompatibility due to heterogeneous metadata descriptions might be avoided by using ontologies as a conceptual backbone [10]. On other hand, the Semantic Web approach for the personalization of e-learning processes is also tightly coupled with the availability of great volumes of reusable educational content. The increasing number of IEEE LOM-compliant Learning Object Repositories (e.g. MERLOT[1] with 10,607 public objects stored, eRIB[2] with 49,761, EdNA Online[3] with 30,300, etc.) demonstrates that having more available Learning Objects means multiplying the opportunities to better satisfy the learners' preferences.

Due to decentralized infrastructure in e-learning systems, the exigency of an "intelligent" support is unquestioned [20]. Multi-agent systems for e-learning and skill management are scattering in many applications [18,19], synergically integrated in semantic

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[1] http://www.merlot.org.
[2] http://www.edusource.ca.
[3] edna.edu.au.

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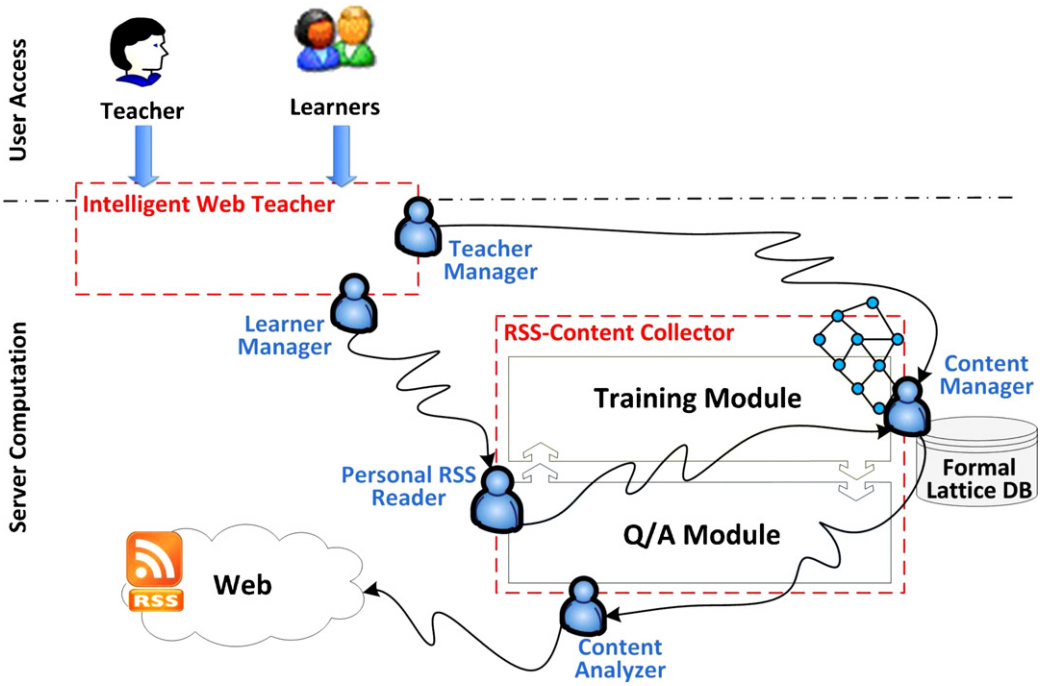

Fig. 1. Architectural overview.

technologies [15]. Furthermore, in the last years, the spreading of Web 2.0 [12] has involved also the e-learning field. Tools like blogs (used to share ideas), wikis (used as a way to construct knowledge in a collaborative way), podcast (used to distribute multimedia files over the Internet) and other Web sharing applications (e.g. Flickr, YouTube and del.icio.us) are exploited by Internet communities in order to work and make business but also to teach and learn. The coherent utilization of the aforementioned tools in e-learning processes is called *e-Learning 2.0*.

The paper presents an e-learning recommender system which enables a contextualized RSS-feeds fruition to support students in their learning path.

Section 2 describes the motivations for this work and its novelty with respect to related works. Then, the architecture overview is given in Section 3, while Sections 4–6 provide a deeper look at the main modules. Finally, Section 7 introduces a sample scenario for the user interaction with the system. Conclusions close the paper.

2. Motivations

The personalized e-learning experiences can really improve the e-learning processes [6]. It becomes more effective and efficient when a great number of educational content requires to be dynamically filtered and assembled with respect to learners' preferences and cognitive states. Then, in the Semantic Web environment, the personalization process should be driven by learners' exigencies and personalized learning content should go to learners with *push logic* mechanisms. Our idea consists of exploiting the Web as a prominent source of educational content for supporting and improving personalized e-learning processes. In order to reach this goal, some important issues will be faced: (a) managing the several types of educational content the Web systems offer (*interoperability*), (b) extracting from the Web and providing to students only educational content that are relevant with respect to the subjects currently treated within their e-learning experiences and suitable for their profiles (*contextualization and personalization*) and (c) driving the Web search activities (for relevant educational content) in order to identify promising Web zones in which to find educational valued content about a domain of interest (*vertical search*). In our approach we propose:

- The adoption of a standard publication language, like Really Simple Syndication (RSS) [12], as a "lingua franca" used to simplify the information management (extraction, filtering, classification, delivery, etc.) and to solve the *interoperability* problem. This choice simplifies our architectural design assuming to (a) search only for Web Repositories and Sites that publish their content using RSS feeds, (b) use RSS fields values in order to perform filtering, classification, etc. and (c) exploit RSS feeds readers and aggregators [12] to delivery educational content to students.
- The introduction of a mathematical model based on the Formal Concept Analysis (briefly FCA) [21] which allows the structuring of the educational content through a lattice representation, contextualized to the e-learning argumentation. Through the building of the relative lattice contexts, FCA enables the representation of the relationships between feeds and topics of Learning Objects. Thus, the system exhibits only content which matches the user experiences.

In literature, several works deal with similar issues [25,26]. In particular, these works make reference to a class of systems that are known as *recommender systems* and apply them to enrich learning experiences. Our approach provides an automatic mechanism to build the learning context that represents learner's current needs, cognitive state and preferences. Final result is a personalized learning experience through ad-hoc educational paths and the elicitation of the feeds content to provide further sources of study and, at the same time, support the generation of customized recommendations. Specifically, main advantages produced by the improvement of the personal learning experience can be listed as follows:

- The improvement of the personal learning environment providing quality content (coming from sources approved by teachers/tutors), related to the interest of learners.