PhD Thesis of Sergio Miranda

Abstract

The main theme of this PhD thesis is IWT – Intelligent Web Teacher – an innovative e-learning and knowledge management platform coming from experiences in national and international research project led by the Excellence Pole in Learning & Knowledge of the University of Salerno.

As a distinctive feature, IWT offers the ability to create and deliver personalized courses by taking into account user profiles and guarantying flexibility in terms of content and learning models. These kind of courses are more efficient and effective than classic and static e-learning courses.

The ability in delivering personalized courses is based on a sophisticated modelling of the knowledge of domain and content as well, by using ontologies and metadata, acquired competencies and learning preferences of the user by means of user profiles and their continuous adaptation.

The validity of this IWT approach has been confirmed by benchmarking solutions, methodologies, models at the state of the art and results coming from many experimentation activities leaded in both educational university and enterprise contexts and described in the following papers:


The main result is linked to the matching between performances of simple and personalized courses measured in terms of user competencies.

Interesting considerations have been made on the experimentation. The IWT approach based on personalized courses seems to gain results better than typical e-learning approaches based on simple static courses. Through the personalization it is possible to involve in learning processes also people having yet high level competences on treated themes and usually unwilling to accept an e-learning engagement.

On the other hand, this approach, even if totally automated, needs a start-up effort for defining right user profiles, designing domain ontologies intended as a right semantic representation of concepts and relationships among them, defining metadata for learning objects, indexing them end describing them in a way as complete as possible for using them in the courses.

Research activities aimed at the study of the state of the art, at the study of the existing models, at the looking for solutions, at the definition of possible methodologies able to create improvements on these key aspects related to knowledge representation in terms of ontologies and metadata and to user profiles representation in terms of competencies on learning domain and preferences on the way to use content.
The approach, of course, has not been just applicative, but it has been oriented to the wide literature of this scientific sector in order to study problems and existing solutions and to define something (also in terms of algorithms) that is valid and interesting for the scientific community. Some idea has been reported in the following papers:


To summarize, after having found models to describe and make up to date the user profiles, computationally efficient methodologies to understand if content for a matter are enough for a set of students, this work have been turned to two fundamental aspects that are the automatic extraction of ontologies directly from content and the automatic definition of metadata for content.

In fact, it usually happens that the material is available and, to take advantage of personalization, it is necessary to create ontologies and metadata a posteriori (... and manually).

In order to automate these operations, we have defined methods to extract ontologies from learning objects and contextually define metadata in terms of technical and pedagogical parameters.

In literature there are many approaches able to extract technical features (format, size, requirements, ...) but there are rare and incomplete approaches able to describe pedagogical aspects as used in standard IMS learning Object Metadata (learning resource type, semantic density, difficulty, time to spend, interactivity, ...). By getting together information theory fundamentals and learning models we have proposed a solution to this kind of problem. This approach, by now, seems to be very good. It has been experimented on a database of more than 2000 learning objects on Mathematics and Computer Science and the results may suggest to apply it in other contexts by following the trend of new information publishing and Linked Data. In other word, a new way to automate the cataloguing of documents: a hot spot for IEEE, BBC, USA Government and many other organizations.