A Pedagogy-driven Personalization Framework to Support Adaptive Learning Experiences

Polyxeni Arapi Nektarios Moumoutzis Manolis Mylonakis Stavros Christodoulakis
Technical University of Crete / Laboratory of Distributed Multimedia Information Systems and Applications (TUC/MUSIC), Chania, Greece
tel:+30 28210 37405/37395/37398/37390, fax: +30 28210 37567
{xenia,nektar,manolis,stavros}@ced.tuc.gr

Abstract

The creation of personalized learning experiences is considered as a necessity to cope with the overwhelming amount of available learning material. This paper presents a personalization framework and an algorithm that allows for the creation of pedagogically sound learning experiences taking into account the variety of the Learners and their individual needs.

1. Introduction

The "one-size-fits-all" solutions are no longer enough to satisfy the Learners' educational needs. Different Learners have different learning styles, educational levels, previous knowledge, technical and other preferences and all these parameters affect the learning function outcome. Moreover, the wealth of content in learning object repositories call for flexible solutions where content is not strictly bound with the learning plan but could be retrieved at run-time and from many sources. Related research areas include Adaptive Hypermedia, Intelligent Tutoring Systems, and Semantic Web [3]. Although each area treats adaptivity from a different perspective, there is a convergence that pedagogy is important and should be represented in a consistent and reusable manner without direct binding to learning resources at design time.

The proposed framework is able to automatically create personalized learning experiences in the form of SCORM packages using reusable learning objects in order to satisfy Learner needs and preferences expressed in Learner Profiles. To achieve this, the system consults Learning Designs (i.e. pedagogical templates) that describe how certain subjects should be taught. This framework has been implemented in a service-oriented architecture built on an experimental digital library of audiovisual content [1].

The main component of the personalization framework (Figure 1) is the Personalization Component. It takes into account the Learner Profile and finds an appropriate Learning Design that will is thereafter applied to the construction of learning experience by binding specific learning objects to learning activities using information from the Learner's profile. Finally, the Transformation Component creates a SCORM package from the intermediate representation of the learning experience.

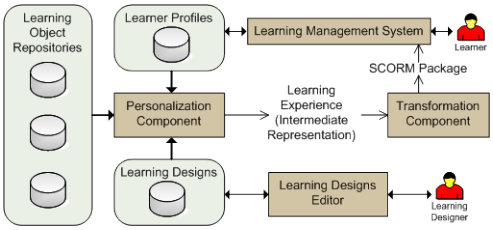

Figure 1. Architecture

LOM is used for the description of learning objects providing a consistent representation that facilitates their retrieval from repositories. If this framework is applied on top of digital libraries, the approach we presented in [1] can be used in order to support multiple context views of digital objects. Information about the learning objectives of each object is important in order to apply this framework. We define a learning objective as a pair of a verb taken from a subset of Bloom's taxonomy [2] (e.g. defines etc.) and a topic referencing a concept or individual of a domain ontology. This can be expressed in LOM using its classification element.

It is assumed that a SCORM compliant LMS is used to deliver the personalized learning experience to the Learner and keep the Learner profile up to date. A special tool, called Learning Designs Editor has been also implemented for the creation of Learning Designs.

2. Learning Designs

Learning Designs are abstract training scenarios that are constructed according to an instructional ontology

(Figure 2). *Training* is composed of *TrainingMethods* that are different ways for teaching the same subject depending on the *LearningStyle* and *EducationalLevel* of the Learner. A *TrainingMethod* consists of reusable *ActivityStructures* built from *Activities*. Each Training, ActivityStructure and Activity has a *LearningObjective* structured as defined earlier. The *LearningObjectType* is used to describe the learning object properties without binding specific objects with Activities at design time. The *related_with* property can further restrict the preferred learning objects connecting them with *DomainConcepts* or individuals in a domain ontology.

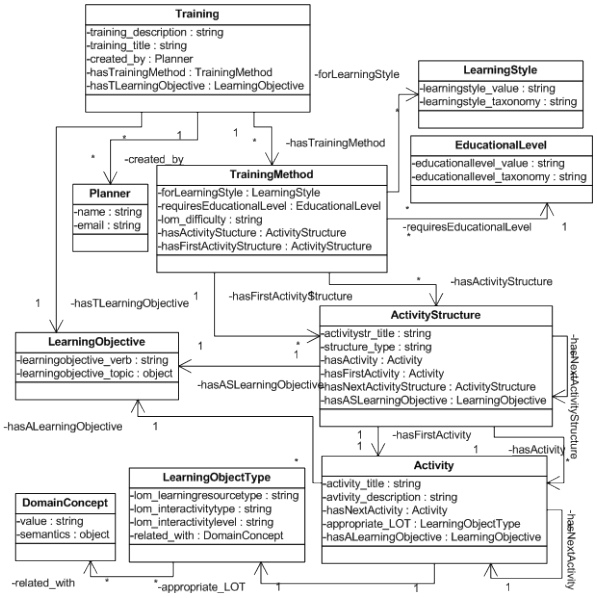

Figure 2. The instructional ontology

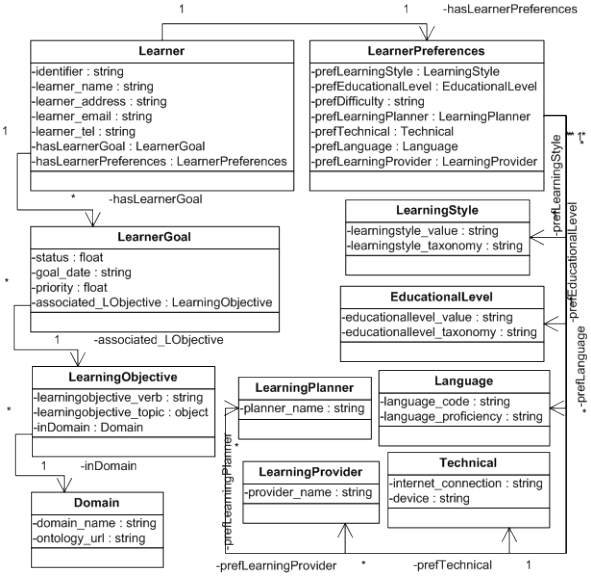

Figure 3. The Learner ontology

3. Learner Profiles

We focus on the elements that should be included in a Learner Model to support the framework presented here (Figure 3). A *LearnerGoal* is expressed in terms of *LearningObjectives* using the structure presented above. It has a *status* property (float in [0, 1]) indicating the satisfaction level of the goal so that one can also infer the previous knowledge of the Learner. The Learner can also define a *priority* for each *LearnerGoal*. Several types of *Preferences* are used: *EducationalLevel* and *LearningStyle* matching with the corresponding elements of the instructional ontology, *Language*, *LearningProvider* who makes available the learning objects, *LearningPlanner* (the developer of learning designs) and *Technical* preferences.

4. The Personalization Component

The Personalization Component considers the Learning Designs and the Learner Profiles and constructs personalized learning experiences that are delivered to eLearning applications in SCORM format. The goal is to find an appropriate learning design that will be used thereafter to construct a learning experience adapted to the Learner's needs. Learning objects are bound to the learning scenario at run-time.

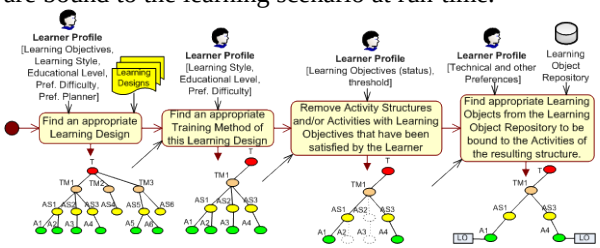

Figure 4. The personalization algorithm

5. Acknowledgements

The work presented in this paper is partially funded by the LOGOS ("Knowledge-on-Demand for Ubiquitous Learning") STREP Project (IST-4-027451).

6. References

[1] Arapi P., Moumoutzis N. and Christodoulakis S., "ASIDE: An Architecture for Supporting Interoperability between Digital Libraries and ELearning Applications", ICALT 2006, Kerkrade, The Netherlands, 2006.
[2] Bloom B.S. and Krathwohl D.R., "Taxonomy of Educational Objectives: The Classification of Educational Goals: Handbook I", Cognitive Domain, Longman, New York, 1965
[3] Brusilovsky P., "Adaptive and intelligent technologies for web-based education", Künstliche Intelligenz, Vol. 4, 1999.