Management of learning styles, competences and access device preferences to alleviate the authoring of standard-based adaptive learning designs

Silvia Baldiris[1], Olga C. Santos[2], Germán Moreno[1], David Huerva[1], Ramón Fabregat[1], Jesús G. Boticario[2]

[1] Insitute of Informatics and Aplications (IIiA), Universitat de Girona, Spain
{baldiris, lauram, gmoreno}@eia.udg.edu, ramon.fabregat@udg.edu
http://bcds.udg.edu/
[2] aDeNu Research Group, Artificial Intelligence Department, Computer Science School, UNED, C/Juan del Rosal, 16. 28040 Madrid, Spain
{ocsantos, jgb}@dia.uned.es
http://adenu.ia.uned.es/

Abstract. The complexity of authoring adaptive learning designs and the extra effort and technical knowledge required for course designers restrains the actual application of adaptive course delivery in real settings. Our research works focuses on alleviating the workload for the course designer by applying artificial intelligence techniques that automate part of the design process. We have designed an integrated user model based in an intensive use of IMS learning specifications for the management of learning styles, competences and access device preferences. This model is used by some adaptation processes that apply artificial intelligence techniques to produce an automated learning design, which enters in the life cycle of the learning process, which covers design, publication, use and auditing of learning processes.

1 Introduction

Authoring of adaptive and adaptable hypermedia can benefit from the application of existing standards and specifications (e.g. reusability and interoperability of designs among different systems and extensions of current design with feedback from its delivery). A review of the state of the art in this field was done in [1] and reported that the 1) authoring task has been the major bottleneck for decades and 2) the main problem in designing standard-based adaptive courses is the complexity to establish the hooks for the dynamic modelling to be performed at runtime. In ADAPTAPlan [2] project we have been working to provide dynamic assistance to course authors by relaxing their design work to provide a simplified set of data (course objectives, questionnaires, contents, services and activities) which is modelled with IMS specifications [3]. With these data, the learning design of the course, in terms of the IMS Learning Design specification can automatically be built. In this paper, we present current works considering the device access preferences when building the learning design of the course, not considered previously.

2 Modeling support for the adaptation process

In order to generate adaptations that alleviate the course design task, users are modelled in ADAPTAPlan in terms of competences, learning styles and access device preferences (see. Fig.1). The data are obtained form the learners interactions in the learning platform. In particular, ADAPTAPlan is implemented on an open source learning platform called dotLRN [4], which supports IMS educational standards, provides accessibility features, and is technically designed to be extensible and supports web services communication. Data to generate the *Learning Style Profile* is computed by applying Felder Learning style inventory [5]. Moreover, an external service to manage user model features following IMS Learner Information Profile (IMS-LIP) is being implemented [6]. In this way, the user learning style is stored as the corresponding user properties in the IMS –LIP implementation. This service also manages the access preferences of the user in terms of IMS Accessibility for LIP specification, so these preferences can also be taken into account at design time in order to adapt the learning design of the course to the user.

Access Device Profile can be queried through an external CC/PP UAProf repository [7]. dotLRN platform is being prepared to extract from the HTTP header the information of the device used. External repositories can be used, such as [8]. Moreover, there are also on-going works integrating a device profile server into dotLRN [6].

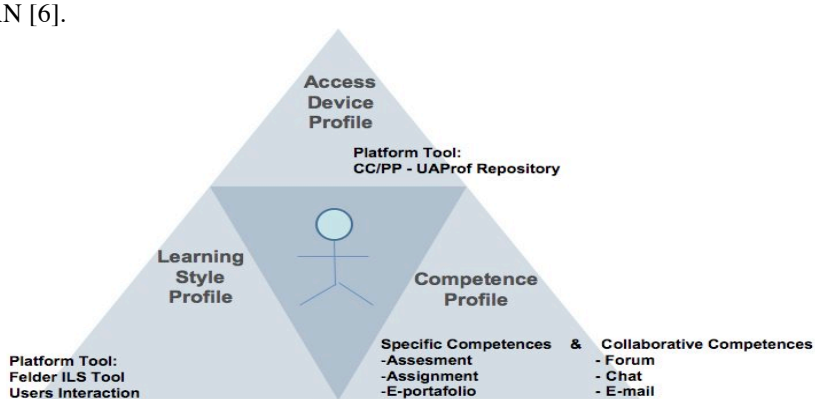

Fig. 1. Interrelations among Learning Styles, Competences and Access Devices

In order to obtain the *Competence Profile*, several educational tools are offered by the platform. In particular, the IMS Question and Test Interoperability is supported by the assessment package which computes the achievements of the user in a standard-based format. Other packages such as assignment and e-portfolio are the base to define specifics competences model; and data from forum package, chat package and e-mails package are useful for the collaborative competences model.

Several implementations can be used for modelling the learning process and in particular, are suitable for supporting the adaptation process required: 1) LORS Package: it is an implementation of Scorm Reference Model [9] and includes an implementation of IMS Metadata and IMS Content Packaging; 2) IMS Reusable Definition of Competency or Educational Objective is used to specify a catalogues of

learning goals [10]; 3) IMS Learning Design Player delivers the adapted learning design. The relationships between IMS specifications are the base to generate adaptation rules [2].

3 Adaptations to automate the authoring process

The purpose of the adaptation mechanism in ADAPTAPlan project defines: 1) the best type of learning resources and the order to present them; 2) the collaborative activities that should be presented to user according with his/her collaborative competences level; 3) the learning resources, no collaborative activities and evaluation resources to deliver according to specific level of competences; and finally, 4) changes on the platform interface and the selection of some learning objects according to the CC/PP profile associated to the learner access device. Figure 2 shows the main elements and characteristics of the adaptation process [11].

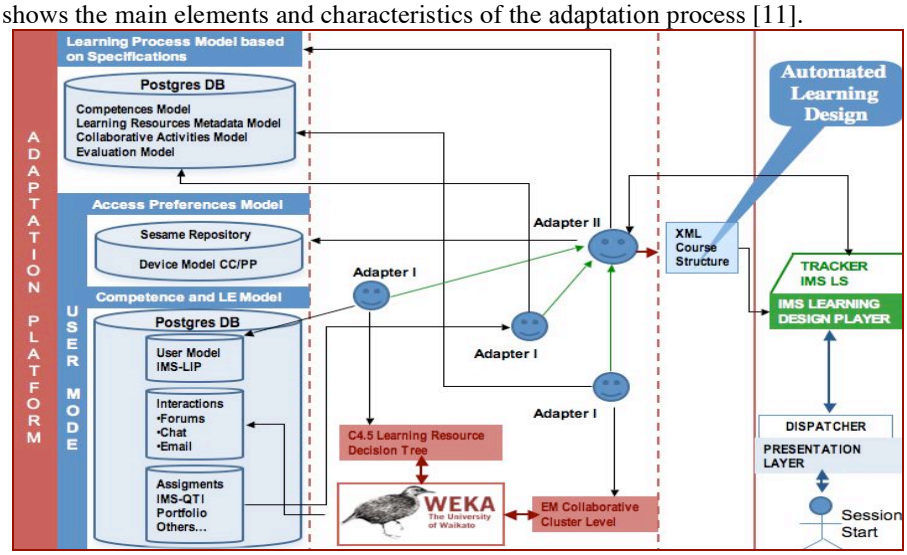

Fig. 2. Adaptation Process ADAPTAPlan Project

With the *Learning Style Model* stored in the IMS Learner Profile as input, Adapter I selects the best order to present learning resource types according to the learning style information. Following previous experiences, this information is stored in a C 4.5 Learning Resources Decision Tree. The *Collaborative model* is developed using database information about the learner's interaction in the collaborative tools. Data is pre-processed and the EM algorithm (Weka Tool) is utilized in order to generate clusters of users according to the collaboration level, as previous experiences in [12]. With the generated EM model, Adapter I process determines in which cluster the student is located and defines the specifics resources to show him.

Adapter II, dynamically and on a second phase, performs the access device adaptation by adjusting learning objects characteristics such as image resolution, weight, colours, dimensions and another measure associated to resources presentation and the html structure, and ignores some inadequate resource for a specific device. This adaptation is based in information available in the metadata object repository. The result of adaptation process is an IMS Learning Design.

6 Conclusions

We have presented some advances achieved within the ADAPTAPlan project, which extend the user features to consider the access device capabilities.

User model data were presented, such as a collection from a pervasive usage of standards and specifications (IMS family of specifications) and from different tools available in a learning platform.

In order to support the learning style and competences adaptation, machine learning techniques are applied. Decision about the order to present learning resources is based on a classification C 4.5 algorithm and the cluster of competences level are composed using EM algorithms.

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