

# Adapting SME Learning Environments for Adaptivity

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## Abstract

*There is a genuine demand for personalization and guidance in learning systems, as well as in general commercial learning systems for the WWW, and further, for the new, emerging Semantic Web. Some isolated attempts towards adaptation are being made without fully responding to this demand. However, systematic frameworks for adaptive content and behavior description are already available in the research on Adaptive Hypermedia (AH). Here we present a novel application of an Adaptive Hypermedia Authoring framework and its principles towards extending an existing SME authoring environment for e-learning, as well as some initial evaluation results.*

## 1. Introduction

Nowadays, along the lines of *learner-centered education*, personalization in learning experiences has become a desired commodity. Many commercial learning sites provide at least some simulacrum of adaptivity to the learner, e.g., in requiring a login, and thereafter addressing the learner by his name. Still, the depth and variety of the personalization in learning offered by e-companies is quite shallow. On-line learning environments tend to be either *Learning Management Systems (LMS)*, such as Blackboard [2] or WebCT [16], that tackle mostly organization problems in the on-line learning experience; or *small scale authoring/delivery systems*, created by SME companies, such as Turpin Vision [15]. However, studies show that there is a demand for more adaptivity in commercial environments [10]. One possible drawback holding companies back from moving more quickly towards the adaptive learning market is the difficulty in creation of adaptive learning experiences.

Adaptive educational hypermedia (AEH) [1], gives a systematic, model-based insight into different levels of personalized learning, as well as authoring thereof.

Thus, a union between AEH and commercial e-learning is desirable. Here, we illustrate this idea by extending a commercial authoring system for learning material, *Content-e*, with a module for authoring of material for adaptive presentation. The module is based on a previous AEH authoring tool, MOT, and a framework for adaptive hypermedia authoring, LAOS.

## 2. AEH Authoring Framework: LAOS

LAOS [7],[11] is a generic framework for *authoring of adaptive (educational) hypermedia*, and the basis of the MOT [6] system, as well as of conversions between adaptive hypermedia and learning systems (AHA! [9], WHURLE [13], and the commercial LMS Blackboard [2]). LAOS defines 5 authoring layers, corresponding to basic AEH high-level components: *domain model (DM)*, *goal and constraints model (GM)*, *user/learner model (UM)*, *presentation model (PM)* and *adaptation model (AM)*. The *DM* contains ALL basic elements of the learning content, similar to a book or reference manual. It defines e-learning content, structure and meta-data, organizing information into *concept maps*. The *GM* filters this large book, extracting elements for the learning event. These elements are pre-ordered; however, adaptation can still change this initial order. Importantly, the *GM* adds pedagogical labels and weights to concepts (e.g., to determine that material is for beginners or advanced learners, etc.). The *UM* stores information on the learner. The *PM* has information on a learner's environment, such as device type (handheld versus desktop), quality of service. The *AM* dynamically uses the above static models, via *adaptation strategies* (or *pedagogic strategies*). The *AM* is further detailed in the LAG model [8].

### 3. The initial systems for AEH creation

#### 3.1. 'My Online Teacher': MOT

The Content-e system extension was inspired by MOT ([6], [12]), an Adaptive Educational Hypermedia Authoring Tool based on the LAOS framework. For the resulting CE/LAOS hybrid comparison, it suffices to know that authors in MOT can create or modify DM and GM maps via the editable web forms, and reuse (parts of) other maps (created by themselves or others). Some authoring tasks can be automated. MOT DM and GM maps can be exported in an XML format called CAF [4] (Common Adaptivity Format). CAF files, together with the LAG language [8] files (storing the maps of the remaining models: UM, GM, AM), represent a *generic intermediate export step*.

#### 3.2. Content-e

Content-e is an online authoring tool for structured content, developed by Turpin Vision [15]. It features concurrent authoring, single source - multiple destination publishing, and a highly modular architecture. This enables it to be extended with new content-types, or interface with other systems via import/export modules. It has a hierarchical organization of content objects: chapters are composed of sections, which are composed of paragraphs, etc. Each type of content object can have a separate authoring interface, allowing special structures and semantics. Content-e was used for authoring of e-learning and multimedia environments for many years for clients from academia and beyond (e.g., TU/e, Spectrum Electronic Publishing, Thieme Meulenhoff publishing, Open University of the Netherlands), for stand-alone and on-line content, as well as CD-ROMs. However, none of these learning products were adaptive.

### 4. Adding Adaptivity: CE/LAOS

#### 4.1. Goals and Design

The goal was to create a LAOS-based authoring tool for adaptation, like MOT, with the 'look and feel' of the Content-e commercial environment. This CE/LAOS module should export CAF files, delivered in AHA! (Figure 1). This goal was divided into 3 sub-goals:

- *Sub-goal 1: implement the DM and GM authoring extension for Content-e (Figure 1), with equivalent functionality to MOT, but functioning in Content-e.*
- *Sub-goal 2: enhance the functionality, as compared to MOT and its previous evaluations [5] and extend the LAOS model support.*
- *Sub-goal 3: improve user friendliness for AEH authoring in CE/LAOS, as compared to MOT.*

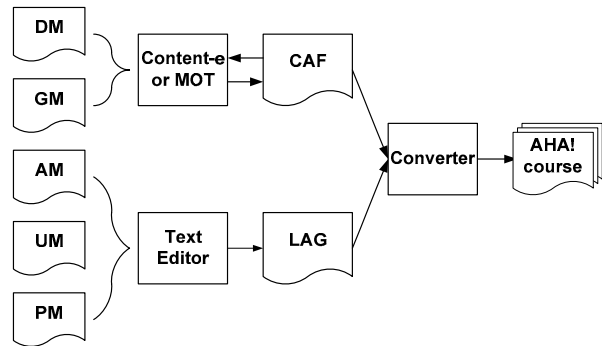


Figure 1 MOT and CE/LAOS: from authoring to delivery and usage.

#### 4.2. Implementation and Output

CE/LAOS was implemented by building two new modules in Content-e (to *import* and to *generate* CAF format files) and two additional content object types (to represent DM and GM models, respectively).

As DM maps are usually authored on a concept basis, concepts in CE/LAOS were defined via a separate dedicated content object. Its special purpose interface provides tools to add and remove attributes, enter content, and create relations to other concepts (Figure 2). For the CE/LAOS DM authoring look and feel, some existing mechanisms in Content-e could be re-used. The hierarchical structure of DMs can be simulated via Content-e documents, which have an inherent hierarchical nature themselves.



Figure 2 CE/LAOS: DM map authoring.

For GM maps, authoring the entire model at once (to support, like in MOT, enhanced semi-automatic transformations from DM maps to GM maps) is more

efficient. Therefore, whole GM maps are represented by single “goal model” content objects. Their dedicated interface shows DM and GM maps side by side, as two tree representations (Figure 3). An author can click & drag *parts* of one or more DM trees to an empty or existing GM tree, to build a new GM map. This allows more flexibility than in MOT (where only entire maps can be converted). (Re-)ordering GM maps is also done via clicking & dragging. Labels and weights are set in the same interface. Unlike in MOT, setting of multiple labels and/or weights at once is possible.

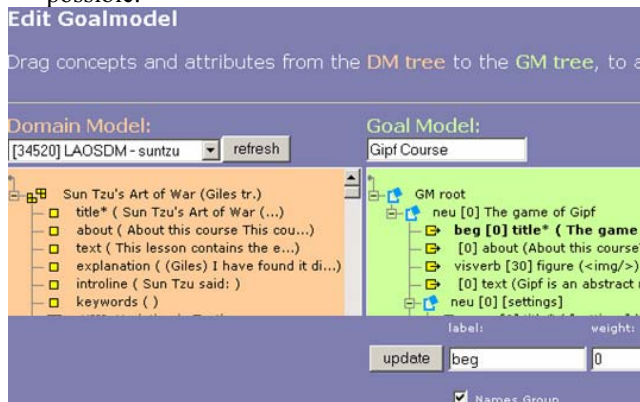


Figure 3 CE/LAOS: GM map authoring.

## 5. Empirical Classroom Evaluation

CE/LAOS was tested with a group of 63 students at the 'Politehnica' University of Bucharest, Romania, in January 2005. The test was done within an intensive, 2-week SOCRATES course on Adaptive Hypermedia [1]. The *tasks* [1] they had to perform in the project were standard operations on DM and GM maps in both MOT and CE/LAOS, and their comparison.

Students answered 3 questionnaires: a standard *SUS usability questionnaire* [14] on MOT and CE/LAOS, and a *specific questionnaire* designed by ourselves, for issues not covered by SUS, and for comments. The results were compared to the *practical task scores*.

From the point of view of the 3 sub-goals to fulfill, the students' performance shows that the first sub-goal, of *re-implementing the DM and GM with the respective MOT functionality*, was achieved.

The second sub-goal, to *extend functionality based on LAOS*, is partially fulfilled. Results show that students understood the system better than MOT in a similar amount of time. However, CE/LAOS's extended functionality was perceived as complex.

The third sub-goal, of *user-friendliness*, is achieved, based on the specific questionnaire results.

## 6. Conclusions

This paper describes one of the first attempts to systematically create authoring environments for personalized learning in commercial settings, thus *adapting SME learning environments for adaptivity*.

## 7. Acknowledgements

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