

# FOSTERING ADAPTIVITY IN E-LEARNING PLATFORMS: A META-MODEL SUPPORTING ADAPTIVE COURSES\*

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## ABSTRACT

E-Learning platforms are very successful in e-education but provide little adaptivity. Personalized courses which adapt to the needs of each individual learner improve the learning progress. In this paper, we introduce a meta-model for enhancing e-learning platforms with the use of adaptivity. This meta-model enables the platforms to provide different courses that adjust to the needs of each learner, especially with respect to learning styles. The paper presents the meta-model by describing the structure of an adaptive course and exemplifies different views for learners with different learning styles.

## KEYWORDS

Adaptivity, Meta-model, E-learning platforms

## 1. INTRODUCTION

Adaptivity is an important issue in e-learning but very few learning systems incorporate adaptivity in today's e-education. Saying that, several adaptive web-based educational systems exist in literature, for example AHA! (De Bra & Calvi, 1998) or INSPIRE (Papanikolaou & Grigoriadou, 2003), providing varying degrees of adaptivity. But these systems have severe limitations, for example, they lack integration, supporting only few functions of web-enhanced education, and the content of courses is not available for reuse (Brusilovsky, 2004). Therefore, the usage of such systems is not very high. E-learning platforms such as Moodle (Moodle, 2005) and WebCT (WebCT, 2005) provide a lot of simple features to administer and create courses. As such, they have become very successful in e-education, but they provide very little or in most cases, no adaptivity at all (Graf & List, 2005).

Addressing the limitations of current e-learning platforms, we designed a meta-model for adaptive courses, which can be easily integrated into e-learning platforms to foster adaptivity. The fundamental concept of this meta-model is that authors create a bunch of individual learning objects. These objects are then composed to form individual courses according to each learner's preferences. The meta-model is based on the Felder-Silverman learning style model (Felder & Silverman, 1988). According to this model, learners are characterized by their preferences in four dimensions: active learners learn by trying things out and working with others whereas reflective learners learn by thinking things through and working alone. Sensing learners like to learn concrete material and tend to be practical whereas intuitive learners prefer to learn abstract material such as theories and their meanings and tend to be more innovative than sensing learners. Visual learners remember best what they have seen whereas verbal learners get more out of words, regardless whether they are spoken or written. Sequential learners learn in linear steps and prefer to follow linear stepwise paths whereas global learners learn in large leaps and are characterized as holistic. Each learner has preferences for each of these four dimensions. Other characteristics of learners such as the state of knowledge and the learning goals are not considered yet, but can be integrated with few extensions to the meta-model.

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This paper focuses on fundamental aspects showing how courses need to be designed to provide adaptivity. A meta-model for e-learning platforms is introduced in Section 2. This meta-model supports adaptivity and at the same time keeps the authoring process of courses still simple. The only extra effort for authors is the declaration of some additional meta-data. As an example for the expressiveness of the meta-model, Section 3 shows possible course instances for different learners with different learning preferences.

## 2. DESCRIPTION OF A META-MODEL FOR ADAPTIVITY

To enable an e-learning platform to adjust to the needs of learners, the presentation of courses needs to be very flexible. Therefore, the introduced meta-model consists of different components, which can be composed individually into a course. In the following, we describe these components (Figure 1) and show how adaptivity can be provided for learners with different learning styles.

Each *course* includes an outline at the beginning, presenting all chapters, and a conclusion summarizing the highlights of the course. Similarly, each *chapter* has an outline and conclusion. To provide global learners with a better orientation, outlines can be presented additionally after each chapter or after each learning unit, whereas for sequential learners outlines can also be completely hidden.

*Content* objects represent the content of the course in small pieces, including also outlines and conclusions. Content objects can include text as well as all kinds of images to support verbal learners as well as visual learners. Additionally, the objects can contain *content links*, for example to additional information about the current concept or to related topics. By providing these links, global learners have the possibility to relate the learned material to other topics and to get additional information. For sequential learners, the links can be hidden to make the course more linear. However, a *collection* of links can be presented, for example, at the end of a chapter. Furthermore, *multimedia objects* can be integrated into content objects. For example, audio objects can include short statements from an expert on a specific topic or question, and interactive animations can help learners to understand by trying out. Therefore, multimedia objects are a good supplement to textual content and can support visual, active, and sensing learners. However, multimedia objects can also be hidden to avoid cognitive load or to provide a more linear course schedule. Also a collection of multimedia objects is possible. In general, slides which are used for traditional education might be applied as content objects after a short revision.

The meta-model also contains *examples*, which are used for better illustration. Each example is related to one or more specific content objects. Examples are especially important for sensing learners. Therefore, courses which are adapted to the needs of sensing learners can consist of more examples than courses for intuitive learners.

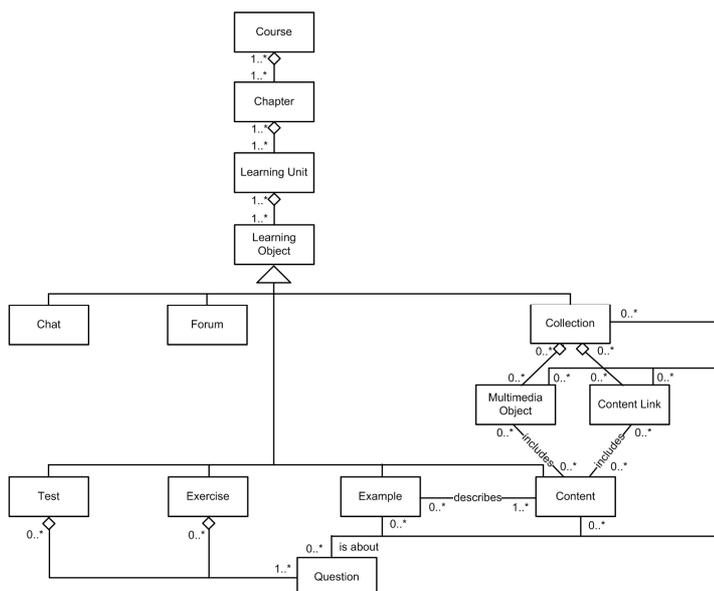


Figure 1: A meta-model for adaptive courses

Furthermore, the meta-model includes *exercise* objects. To provide learners with opportunities to practice, exercise objects consist of several questions about interpreting predefined solutions or developing new solutions. Because active learners tend to prefer to try something out by doing exercises, a course for these learners can include more exercises than a course for reflective learners.

For testing the acquired knowledge, the meta-model contains *test* objects. The results of the tests are available for the learners afterwards. The questions contained in such a test can be about facts or concepts, refer to an overview or to details, be based on images or text, or deal with interpreting or developing solutions. Each question is related to the learning object(s) it is about. Thus, learners can be easily guided to explanations if they need hints. Tests and also exercises can be adapted, for example, with regard to the number of questions and their location in the course. Because the learning progress of sequential learners is linear, they prefer to be tested in shorter intervals than global learners who need more time to get the big picture of a topic. For the latter, tests at the end of a chapter are more suitable.

Communication is an important issue, especially for active and verbal learners, providing them with an opportunity to work together, discuss particular topics, and ask for explanations. To enable the learners to communicate with each other as well as with teachers, *forums* and *chats* are integrated in the course. For instance, the course can include content specific forums/chats, where learners can discuss specific topics of the course, and general forums/chats, where learners can talk about more general issues. Additionally, a virtual office hour, where learners can ask questions by chatting with their teachers at a predefined time, can be integrated.

### 3. ADAPTED COURSE INSTANCES

As described in the previous section, the meta-model facilitates a lot of possibilities to generate different course instances from one course. As an example, this section presents two possible course instances from a course about XML - one for a sequential learner and one for a global learner.

A course instance for a sequential learner can be designed in the following way: the course consists of equally structured learning units, whereby each learning unit includes content objects, examples, exercises, and concludes with a test object. To ensure a regular pace of complexity, content objects do not include content links but a list of links is presented after the content and example objects. Because sequential learners usually navigate through the course by clicking the next button or the back button, these buttons will be highlighted. Figure 2 shows a typical presentation of a content object and additionally gives an insight into the schedule of the course instance.

A course for global learners should not be as regular as the course for sequential learners. An example course instance for global learners can offer the following structure: exercises and test objects appear not per learning unit but in extra units at the end of each chapter. Links to additional or related content are presented immediately in the content object, even if these links lead to more complex topics. For a better orientation, an overview of the course can be viewed easily by clicking on a drop-down listbox next to the back and next button. Figure 3 shows a typical presentation of a content object for this course instance and its schedule.

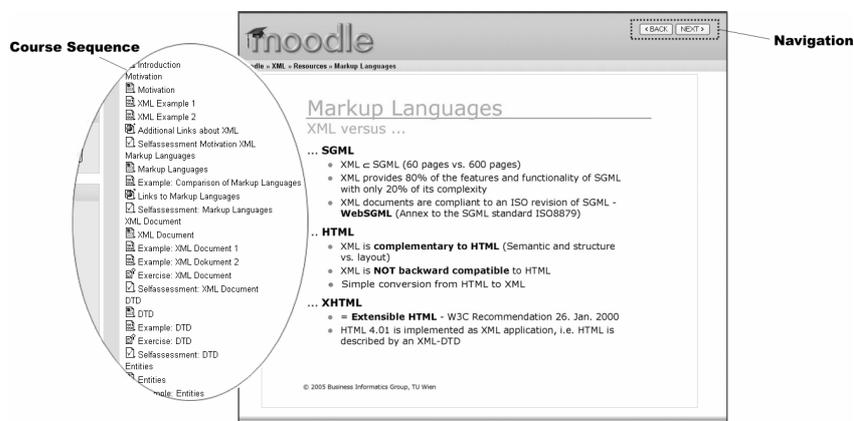


Figure 2: An example for a course fitting to the needs of sequential learners

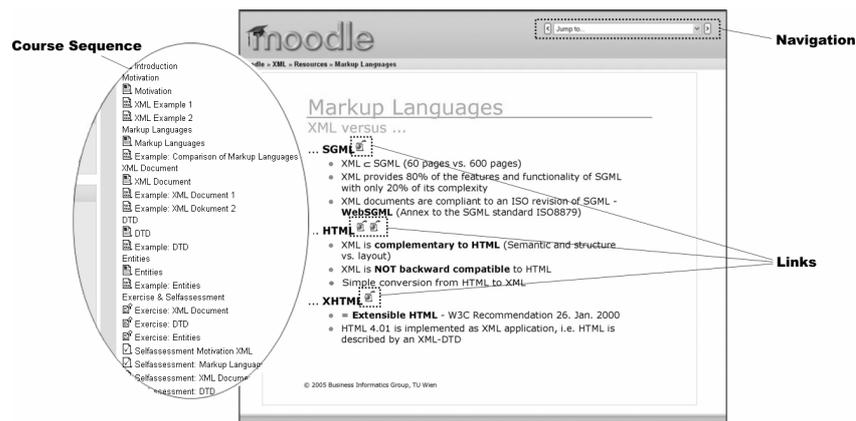


Figure 3: An example for a course fitting to the needs of global learners

These two course instances include three possible differences. They are structured in a different way, the content objects may or may not include links, and the navigation is designed once by showing a drop-down listbox including all learning objects and once by highlighting the next and back button. But there are also other differences possible, for example, some global learners prefer to see the outline of a chapter after each learning unit to orientate themselves. Furthermore, the dimension of sequential versus global learners is only one out of four dimensions in the Felder-Silverman learning style model. Combining all possible differences of all four dimensions results in a large number of different course instances, each one fitting the specific personal characteristics of a learner.

#### 4. CONCLUSION & FUTURE WORK

This paper presented a meta-model for adaptive e-learning courses. Integrating the meta-model into an e-learning platform enables the platform to provide different course instances for different learning styles out of a collection of learning objects that has to be created only once. Therefore, each learner can get the course instance which fits best to his/her learning style.

Currently, we are implementing the meta-model as well as a feature to generate different course instances into the open source e-learning platform Moodle (Moodle, 2005). These extensions permit a static way of adaptation. Our future work will also focus on dynamic aspects trying to detect the learners' learning style from their behavior during the course and using this information to assign a suitable course instance.

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