A Descriptive Markup Approach to Facilitate the Production of e-Learning Contents[1]

Pablo Moreno-Ger*, Iván Martínez-Ortiz#, José Luis Sierra*, Baltasar Fernández-Manjón*
(*) *Dpto. Sistemas Informáticos y Programación. Fac. Informática. Universidad Complutense de Madrid. 28040, Madrid (Spain). {pmoreno,jlsierra,balta}@fdi.ucm.es*
(#)*Centro de Estudios Superiores Felipe II, Aranjuez, Madrid, Spain. {imartinez@cesfelipesegundo.com}*

Abstract

In this paper we show how descriptive markup technologies can help teachers in the production of learning content that later could be used for many different purposes with different pedagogical approaches and for many different platforms. Our approach is illustrated using a manual-writing *metaphor for the production of learning contents in the Computer Science domain.*
Keywords: *Production of Learning Contents, Descriptive Markup Languages, Authoring Metaphor*

1. Introduction

High-quality contents are the solid base behind most pedagogical approaches. The chosen encoding format for these contents should ensure the durability, retargeting and maintainability of the encoded contents. All these issues have been successfully addressed by the modern publishing industry with the help of descriptive markup technologies [3]. These languages encourage the representation of the logical structure of the documents instead of how they are subsequently processed and their independency of proprietary formats. Besides, descriptive markup can be easily understood by authors, since it can be adapted to their particular terminologies and expertise.

In this paper we propose a process model to take full advantage of descriptive markup technologies to help teachers in the production of durable, easy-to-retarget and maintainable e-learning contents, based on our previous work on the production of these kinds of content [4], as well as on the extension of the approach to the production of content intensive (e.g. educational and hypermedia based) applications [7]. We also illustrate this approach with an authoring metaphor for the production of learning contents in technical domains.

[1] The Spanish Committee of Science and Technology has partially supported this work (projects TIC2002-04067-C03-02, TIN2004-08367-C02-02 and TIN2005-08788-C04-01).

2. The Document-Oriented Production Process Model

In this section we propose a production of learning contents based on a document-oriented process model, specially well-suited for domains where learning contents can be exposed as documents with well-defined, regular and recurrent structures (e.g. manuals in technical and experimental learning domains). In the following subsections we outline the products, activities and the participants involved in this model.

2.1. Products and activities

The products and activities involved in the document-oriented production process model are sketched in Fig 1.

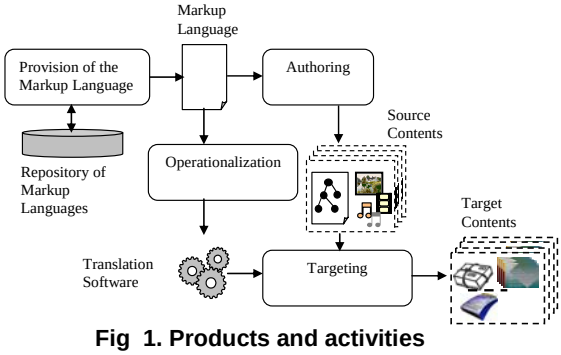

Fig 1. Products and activities

The objective of the *provision of the markup language* activity is to choose and/or to devise the *markup language* (close to and familiar to the teacher's vocabulary) that will be used to mark the documents up with the learning contents. This markup language will be chosen and/or adapted from a *repository* of pre-

existing markup languages, or specifically formulated for the domain at hand. A standard markup metalanguage (like SGML or XML) can be used for this purpose, which will facilitate future combinations and adaptations.

The aim of the *authoring* activity is the production of the *source contents* with the learning materials. The main document will be marked up with the provided language, including references to multimedia resources. In this activity authors, who are only required to have basic skills in the use of descriptive markup, can use their favourite text editors to edit and mark the documents up.

During the *operationalization* activity the *translation software* required to transform source contents into the required formats is provided. As said before, the adoption of a common metalanguage will facilitate the provision of this software.

Finally, the *targeting* activity is oriented to the production of the *target contents* in different formats and for different platforms using the translation software.

2.2. Sequencing of the activities

The activities introduced in the previous subsection are sequenced as depicted in Fig 2. As suggested in this scheme, the process is author-driven. It starts with the *authoring* activity (1), where the source contents (main document and related resources) are provided. In order to structure these contents, a suitable markup language is provided during the *provision of the markup language* activity (2). Next, the contents are structured accordingly at an additional authoring step, and suitable translation software is also provided at an *operationalization* step (3). Finally, source contents are transformed into target ones by processing them with the translation software during *targeting* (4). If the result is not satisfactory, further authoring and/or operationalization can be carried out (5).

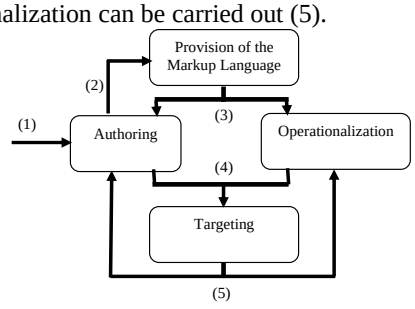

Fig 2. Sequencing of the activities

It is important to point out the iterative nature of this sequencing. Indeed, it is possible to carry out several authoring or targeting steps in order to refine a particular bundle of source contents. In addition, it is also possible to perform additional operationalization steps in order to improve and/or to fine tune the translation software. Finally, it is also possible to adapt the markup language by performing additional steps for the *provision of the markup language*. Modularization mechanisms in technologies like XSLT, or proposals like [8], can be very valuable in managing this iterative behavior.

2.3. Participants

The process model discriminates between two main kinds of participants: *authors* and *developers*. While authors cope with the pedagogical aspects, developers address technological concerns. In addition, both types of communities play active roles in the four activities contemplated by the process.

The main workload of authors is during the authoring activity, where they provide the source contents. However they also play fundamental roles during the provision and operationalization, guiding the developers in the aspects concerning the structure of the documents and the additional presentation and interaction requirements that better fit the desired pedagogical strategies. Finally, their participation is also very valuable during targeting, in order to evaluate the adequacy of the resulting products.

In turn, the main responsibilities of the experts are the adaptation and creation of the markup languages and of their associated translation software. They also provide support to authors during the authoring activity, and they evaluate the quality of the translation software from a technological point of view.

3. An Example: Production of Learning Contents in Computer Science

Computer Science is a domain where a great amount of knowledge can be organized in the form of *manuals* covering particular subjects. This leads to a *manual-writing* metaphor for authoring in this domain, according to which the production of learning contents is tackled by writing manuals for specific themes. In the next subsections we detail this metaphor in terms of the document-oriented production process.

3.1. Provision of the Markup Language: DocBook

There are two different factors that must be taken into account when choosing a markup language for a learning domain: (1) the adequacy of the language to

the domain and (2) the provision effort. The latter can take advantage of pre-existing languages as a starting point, which can be modified to suit specific needs. For the computer science scenario we have identified DocBook, a well-known markup language for technical documentation as a suitable starting point [5]. Additionally DocBook enables us to adapt its specification to accommodate specific markup needs in particular scenarios. This inherently supports the iterative nature of the document-oriented process model.

3.2. Authoring: DocBook's use guidelines

Using DocBook, authors can create source learning contents in accordance with the manual-writing metaphor. In addition, by following additional guidelines, the authors can enable a broader spectrum of potential uses for the produced contents. Authors can identify the highlights of each section. As a consequence, a set of slides that can be used by teachers as a teaching aid during lectures could be extracted. Authors can also make use of conditional text in order to enable the generation of personalized target contents from a single source. Finally, the identification of sections as reusable Learning Objects (LOs) [6], which aggregate the more basic objects represented by their subsections, and which are aggregated in higher-level objects given by the super-sections containing them, turns DocBook into a mechanism for authoring collections of LOs according to a manual-writing metaphor. This point of view imposes additional rhetorical constraints on the writing style since authors are compelled to think about individual sections as LOs with a well-defined pedagogical goal.

3.3. Operationalization and Targeting: DocBook's Operational Support

Since DocBook is an open source and widely accepted technology, a full range of freely available software tools have been developed. Therefore, during operationalization we have reused a considerable amount of pre-existing software. In addition, as DocBook is also an XML application, all the existing XML processing technologies [1] can also be applied.

The writing guidelines followed during authoring, together with the translation software provided during the operationalization step, enables the transformation of source DocBook manuals into book-like printouts, classroom slides and even content conforming the IMS Content Packaging Specification.

4. Conclusions and Future Work

In this paper we have presented a process model for the production of durable, easy-to-retarget and maintainable learning contents. We have also illustrated the approach in the implementation of a *manual-writing* metaphor for the production of learning contents in Computer Science. Choosing a mature markup technology (DocBook), the approach can be carried out limiting the development costs.

Perhaps the most delicate conclusion is that this process may seem burdensome to the authors, but it does facilitate their work in the long term. Indeed, notions like LOs or additional markup may imply a work overload. However, this process facilitates all these tasks by reducing the effort required while maintaining the long-term associated benefits such as reuse, retargeting and adaptation.

As future work we are planning to experiment with other (pre-existing and new) markup languages. We are also planning to apply the manual-writing metaphor to other domains and to exploit other potential uses of the DocBook documentation (e.g. checking accessibility constraints regarding the W3C accessibility guidelines). We also want to address the automatic generation of Sharable Content Object Reference Model (SCORM) compliant courses from DocBook manuals.

5. References

[1] Birbeck, M et al. *Professional XML 2nd Edition*. WROX Press. Birminghan,UK. 2001

[2] Collis, B; Strijker,A. Technology and Human Issues in Reusing Learning Objects. Journal of Interactive Media in Education 4. 2004. www-jime.open.ac.uk/2004/4

[3] Coombs, J; Renear, A; DeRose S. Markup Systems and the Future of Scholarly Text Processing. *Communications of the ACM* 30(11), 933-947. 1987

[4] Fernández-Manjón, B; Fernández-Valmayor, A. Improving World Wide Web Educational Uses Promoting Hypertext and Standard General Markup Languages. *Education and Information Tech.*, 2(3), 193-206. 1997

[5] Martínez-Ortiz, I.; Moreno-Ger, P.; Sancho-Thomas, P.; Fernandez-Manjón, B. Using DocBook to Aid in the Creation of Learning Content. EduTech 2005. Perth, Australia, October 20-21. 2005

[6] Polsani, P. Use and Abuse of Reusable Learning Objects. *Journal of Digital Information* 3(4).2003

[7] Sierra, J. L; Fernández-Manjón, B; Fernández-Valmayor, A; Navarro, A. Document-Oriented Construction of Content-Intensive Applications. *Int. Journal of Softw. Engineering and Know. Engineering*, 15(6), 975-994. 2005

[8] Sierra, J. L; Navarro, A; Fernández-Manjón, B; Fernández-Valmayor, A. Incremental Definition and Operationalization of Domain-Specific Markup Languages in ADDS. *ACM SIGPLAN Notices*, 40(12), 28-37. 2005