

Learning Object Based System and Training Material for Digital Printing

*Asta Bäck and Helene Juhola
VTT Information technology
Espoo, Finland*

Abstract

The paper presents the CustomDP system for managing and using training material consisting of learning objects. Content is more flexible to use and update with the help of learning objects. Learning objects may be combined into aggregations customised according to learners' needs. The primary format for content creation is XML, but also other formats can be included. Automatic conversions to different formats or terminals are possible with the help of XML. The content in the CustomDP system can be viewed as HTML and PDF. The PDF files can also be used as originals to digitally print customised training booklets. The system is currently being tested by using it in training and education. The content could be utilised as the basis for European education in digital printing, and it can easily be further complemented with more content. The system has support for multiple languages.

Introduction

It is a challenge to find relevant and up-to-date training material, particularly in technical vocational training. Technologies develop quickly, and the learners have varying needs, which would require high customisation capabilities. Fortunately, two important developments can be utilised to face these challenges. The first of these relates to content management, and specifically to the idea of learning objects. The other development deals with multiple channel publishing technologies, particularly with XML and digital printing.

The work that is presented in this paper is based on a European Leonardo programme project, called CustomDP. The project has two main goals. First, to create a system that supports managing and using training material as learning objects and their utilisation both in web and print, and second, to create content as learning objects. Content relating to digital printing has been created during the project. The project both supports the utilisation of digital printing, and it produces content that teaches it.

Interesting questions from the research point of view are how the idea of learning objects works in practice from content creators', teachers' and learners' point of view, and what kind of system support is needed to manage and utilise these objects.

Educational Standards

The idea of learning objects is to improve the usability of training material. Content can be reused as learning objects, and combinations can be created and modified to meet the requirements of different users and courses. Content is also easier to update, because updating can be made object by object when the need for updating is recognised. There is no exact definition to characterise a learning object. For example, the IEEE Learning Technology Standards Committee (LTSC) defines a learning object as any entity, digital or non-digital that can be used, re-used or referenced during technology-supported learning³. Almost anything can be regarded as a learning object.

An important effort in facilitating learning object based content creation and sharing is the USA DoD's Sharable Content Object Reference Model (SCORM) initiative¹ (DoD, Department of Defence). This reference model aims at making it possible to share eLearning content between applications. The SCORM recognises three main levels: assets and sharable resources (which typically are single files, such as image or audio files), Sharable Content Objects (which is the main container for the training content) and Aggregations (which define in which way the content should be presented to the users, "table of content"). The SCORM deals only with digital content.

Our project decided to adopt ideas presented in the SCORM. But, in line with the LTSC definition, we also wanted to support managing non-digital content items, such as printed books, at metadata level.

The small unit size of learning object based content management sets higher requirements on metadata than traditional content. A lot of work has been done to define suitable metadata vocabularies for educational purposes. The most known metadata vocabulary relating to educational content is the standard for "Learning Object Metadata" (LOM)³ released by LTSC. The standard provides a conceptual structure for metadata, a description of each entry consisting of element name, definition, data type, and field length. LOM can be used as starting point for planning learning objects descriptions. The IMS Global Learning Consortium has published an implementation guide⁴ with instructions for the technical use of LOM based metadata.

LOM like other existing public metadata vocabularies (e.g. Dublin Core) is a good starting point and make it possible to establish basic cross application

understanding of the content. We took the LOM vocabulary as our basis, and chose the relevant metadata fields.

Unfortunately these general metadata vocabularies cannot include enough depth to describe a single subject, like digital printing. The best approach would be to create a common ontology or terminology for the subject area at industry level.

A vocabulary for describing digital printing related training material was created in our project. We chose two levels to describe the content: top level which deals with the main process steps and a list of keywords for more detailed descriptions.

Multiple Channel Publishing

World Wide Web consortium's (W3C) eXtensible Markup Language (XML) is the key technology to multiple channel publishing. Utilising the mark-up, content can be converted automatically to different formats. XML can also be utilised to exchange data between systems.

For the CustomDP system, the preferred format for the content creation is XML according to a DTD that has been developed in the project. Multiple requirements were taken into account when designing the DTD: ease of authoring, strength of expression particularly relating to the educational content, and renditioning in print and web.

There is, however, a lot of existing material that would be cumbersome to convert into XML, and there are content types that cannot be expressed in XML. Therefore, the system also supports including other formats than XML. These files can either be imported linked to the corresponding XML file, or they may be imported separately as so called sharable resources, and then utilised by several XML files.

It is also possible to include information of such training material that cannot be imported into the system. This type of content is called the referenced content. It may be links to other websites, or even information of non-digital content. This way the system can also be used as a databank for all types of training material.

Workflow

Creating Content and Aggregations

The idea in content creation is to give people the chance to contribute to content creation by authoring a learning object out of a topic they know about. There is no need to link it to a certain aggregation. The CustomDP system does not directly support content creation, but the authoring is done outside the system. Any authoring tool supporting DTDs may be utilised.

The author must describe his or her content utilising our metadata vocabulary. This can and partly must be done when authoring the XML file, but metadata can be modified and complemented once the content is in the system. The imported content must pass the validation before it will be visible to other users of the system. Validation is made by the authorised CustomDP content validator.

Content creator can also import sharable resources and referenced content.

The key functionality of the system is to support creating aggregations out of the learning objects. The aggregations have a hierarchical structure. A course is the top level, and it consists of modules; a module consists of topics, and a topic consists of the actual content, the learning objects or referenced content.

Using Content

The idea of the system is to be a database of training material; therefore the users can search the content. The content is accessible at all existing levels. Of course, also a specific aggregation can be created for a group of people studying a course together.

Users can give feedback of the content by writing a review of a single objects and by assessing a course.

Content can be viewed either as HTML pages or a PDF file. The PDF file can then be used to study the material electronically as an eBook.

Most importantly, the PDF file can be used to print the material.

Practical Experiences

Content Creation

It is currently unfamiliar to most people to author content in XML, which means that they need to learn new skills. Even though XML can to some extent be hidden behind the user interface by utilising an authoring tool, some basic understanding is needed. The authors must learn to know the elements of the DTD in order to utilise all the available features.

Metadata

Our assumption was that metadata is important for easy utilisation of the material. We chose a number of metadata elements, and made some of them optional. It is difficult to give all this metadata for two reasons. It is time consuming, and what is more problematic, it is difficult to determine the values for elements in a consistent way. For example, the value for typical learning time for a typical user is an interesting piece of information, but one may ask, if it is really possible to determine it in a comparable way for different types of content. Also leaving some metadata elements optional is problematic, because then the searches give incomplete results.

Managing Content and Courses

Our system supports customisation in two ways. The system gives content creators and teachers the opportunity to create new aggregations, either from scratch or by modifying and utilising existing aggregations. The learners can make customised printed documents out of the existing collections by creating versions that include only those parts they are interested in.

The work needed to create courses can be reduced by utilising the intermediate aggregation levels, in other words modules and topics to create content packages. This is the key to quick customisation.

When content is created in modular fashion by several people and over a longer period of time, it is difficult to avoid some overlapping in the content. This is the price we must pay for this type of an approach.

Digital Printing Related Content

The content we have created and gathered so far covers the main technologies and processes related to digital printing. The material has been assessed by an outside expert to make sure that it covers the needs of people who want to learn these new technologies. Because the system manages content at object level, it is also easy to add new content when needed.

Now the content divided is into the following topics

1. Introduction to digital printing
2. Non-impact printing methods
3. Reproduction of digital printing
4. Finishing operations
5. Materials
6. Digital printing systems and workflow
7. Variable data printing
8. Quality evaluation and measuring
9. Business models and the cost of digital printing

The content is in English, but the system supports multiple languages, and the user interface already supports the project languages (Finnish, Swedish, German, Dutch and Greek).

Using Content as a Learner

The content and system are currently in practical testing within the project partner organisations in their training. There seems to be big differences in the number of times that the learners have logged into the system during their course, varying from only seven up to 42 times. Most students have told in their feedback, that they only had utilised the material on the screen. Printing the content may involve some costs, which may be inhibitive to students. Offering the PDF version for offline usage is assumedly convenient for the learners, but it prevents us from getting detailed information of how much and which parts of the content the users have really utilised.

Conclusion

The system offers a way to combine electronic and printed training material. We can see different usage scenarios for the system. It could be used by a school, a group of schools and by the industrial sector to collect and manage training material for their subject. Links could be built to a digital printing facility to support easy ordering and printing of course material. Also, connecting a payment system is a requirement for the future, so that people would be willing to submit content into the system with the prospect of getting some reward later when the content is used. The existing content would make it possible to use it as a basis for a printing related portal.

References

1. Dodds, P. & al. (ed)., Advanced Distributed Learning. Sharable Content Object Reference Model, Version 1.1. 223 pp. 2001. (<http://www.adlnet.org/>)
2. IEEE Learning Technology Standards Committee (LTSC). Learning Object Metadata (LOM). Draft Document v2.4. 16 November 1998
3. IMS Learning Resource Meta-data Specification. (<http://www.imspjproject.org/metadata/index.html>)

Acknowledgements

The work presented in this paper has been carried out in an European project funded by the EU Leonardo da Vinci II programme (programme supporting vocational training). The project consortium has three types of partners: system developers (VTT Information technology, also the co-ordinator, and Chemnitz Technical University, Germany, The University of Art and Design Helsinki, the design for the user interface and page layouts), educators who also act as content creators, (Politis Research from Greece, the GOC-Centre for education and labour market in the graphic arts and media sectors from the Netherlands, the KTH Royal Institute of Technology, Div. of Media Technology and Graphic Arts from Sweden and the Finnish institutes the AEL Centre for Technical Training and EVITech Espoo-Vantaa Institute of Technology, EGIN, European Graphic Arts/Media Industry Network), and company partners (M-Real, a paper manufacturer, SanomaWSOY Oyj, a Finnish publisher and a user of digital printing technology, and DOT Imaging, Greece, who acts as a company test user.).

Biographies

Ms. Asta Bäck received her Master of Science degree in printing technology and graphic arts from the Helsinki University of Technology in 1983. Since then she has worked as research scientist and project manager at the Technical Research Center of Finland (VTT). She is now senior research scientist at the multiple media research field at VTT Information Technology. The main focus of her work has recently been in analysing and developing solutions for multiple media publishing, and using ICT in learning and collaborative work. She is currently the project manager in an international project (CustomDP) that develops a system and content for digital printing.

Ms. Helene Juhola, Research Manager of Media Research Field at VTT Information Technology, Finland. She holds the M. Sc. Tech. degree in graphic arts and information technologies from the Technical University of Helsinki. VTT Media research field is committed to supporting both printed and electronic communications and to developing technologies to combine these two in a user-friendly way. She is TAGA Board member, vice chairman of the IARIGAI Council and the coordinator of CustomDP project.