INTRODUCTION – LEARNING IN THE INTERNET AGE

E-Learning is to become a vital pillar in the thriving educational industry in the postgraduate sector. It also affects the way of learning in the more traditional environments of universities. These institutions have to deal with a rising number of students, urging academic staff to strive for new ways of communication, mainly in introductory courses with hundreds of students, in order to maintain a minimum of personalized learning support. Students are very well aware of the possibilities of the Internet as an information and communication medium. E-Mail has by far become the preferred means of asynchronous communication. Furthermore, the Web is used intensely by lecturers and students to post and retrieve content of interest.

In universities, comprehensive Learning Management Systems (LMS) are gaining ground, allowing multiple ways of interaction between students and academic staff. While these tools support complex transactions and offer many administrative functions, they typically support the authoring process of online learning material only poorly. This is a serious shortcoming, since the development of heterogeneous, hypertext-based, multi-media online materials is a strenuous task. Issues of component integrity arise, alternative learning paths have to be synchronized, and redundancy has to be controlled. As Web-based learning material is unlikely to completely replace paper print versions, electronic material has to be considered as an additional publication channel to be served. Thus, the usage of the Web in learning environments creates a strong demand for cross-media publishing. Authoring for diverse types of media and deploying content through multiple channels in a learning environment are both very costly matters. The development of suitable processes and tools are destined to become important issues with respect to the diffusion of E-Learning.

This paper reflects important requirements for educational media imposed by current learning scenarios. It depicts a sample of pragmatic and more sophisticated approaches towards authoring of Web-based learning material. This is done on the base of experiences of our research group in adapting E-Learning elements to existing lectures and in cooperating with lecturers from different universities in the development of modular Web-based courses.

TYPES OF MEDIA IN E-LEARNING

Traditionally, learning materials are provided in a printed form. It is quite common to supply students with a handout of written material which is relevant for the lecture or later self-study. Such documents are often organized as linear text chunks, comprising full sentences and including tables, graphics, and pictures. The layout should be according to regular printed
material, e.g., A4 format with a 12 pt Times Roman typeface. A lecturer uses presentation slides to illustrate the important lines of thought during a classroom lesson. These slides often contain keywords or short sentences which underline the statements which are passed orally. Additionally, formulas, tables, graphics, and pictures are shown. Regardless whether slides are presented in print or electronically: Due to visibility restrictions, the size of the text and illustrations on presentation slides must be arranged accordingly. A typical layout for texts on slides would be based on a font like 24 pt Arial. Handouts of these slides may complement or even substitute traditionally written text documents.

Learning materials may also be distributed in digital form. This may be done on a physical medium like a CD or through the Web which is a comparatively new way of publishing (learning) content. The provision of electronic documents is quite straightforward since almost all learning materials are created using text processors and graphic editors and, hence, are available in digital formats. Any printable electronic material, even presentation slides or handouts, may then be used as a source for Web content; this material should be provided in a portable standard format like PDF or HTML. However, only the use of special features such as hyperlinks, animations, audios, and video inserts will provide an incentive to use the learning material online. If there is no added value to the user in employing Web technologies, digital documents are almost certainly destined to be a mere source for printouts.

**REQUIREMENTS FOR THE DESIGN OF MULTI-MEDIA CONTENT**

To make use of the specific advantages of different medias and to offer several medias to achieve the learning objectives, learning materials should (1) be easily transferable to different target formats, including online presentations and printable text-oriented documents. In order to limit the maintenance effort it is (2) desirable that content may easily be reused in a different context and (3) be adapted to changing needs. An important issue is (4) the need to share materials with other authors. Finally, the content should (5) present a granularity that allows an integration into any type of grouping, sequence, and navigation system.

All these requirements have as a common denominator that basic learning content should be easily adaptable to different purposes. To achieve this property it is desirable that the learning content source is basically independent from both authoring and presentation applications, and is sufficiently information-rich to match the specific requirements of the target media. Fig. 1 illustrates the corresponding authoring and presentation generation process.

![Fig. 1 Traditional authoring process (left) vs. XML-based authoring (right)](image-url)
Commonly used office packages do not distinguish between the creation of content and its representation. At the very moment an author creates content, he or she is confronted with the problem of its layout. The structuring of these documents is oriented towards specific views of either text pages or presentation slides. For the adoption of existing material or the generation of different formats, the user depends on the import and export facilities of these tools.

With respect to the general usability of contents, an open format is preferable. A very promising text-oriented description format for structured documents is the Extensible Markup Language (XML) which is particularly well suited for use in Web-based applications. This markup language allows for the introduction of structure elements specific to learning material.

EXPERIENCES WITH AUTHORING OF E-LEARNING CONTENT

Since 1999, the Research Unit Information Engineering at the Institute of Information Systems at the University of Berne has been developing course material with E-Learning support. The course management tool WebCT has been chosen as a technical backbone of our E-Learning approach. The primary goal was not to substitute classroom lessons but to complement our lectures with new means of communication and interaction. We evaluated three different approaches for the design of learning material which may be used either in printed form or online in a Web browser.

The (obvious) first approach to directly transform the existing base of PowerPoint presentations to HTML has proven to be unsatisfactory for several reasons. In particular, the linearity and sheer number of slides in a presentation (typically 150 to 200), was seen to be a problem by students. Even in the case of PowerPoint-derived handouts, the existing structure of the content is difficult to perceive; on the Web, hypertext navigation beyond the level of a complete slide show proves to be almost impossible. To exploit the standard navigation of WebCT, we wrote a PowerPoint to HTML converter which performs the following three tasks: transforming a single slide into an image in order to preserve the original layout, creating additional navigation aids for linking a sequence of slides to a particular content entry line, and generating hypertext links based on existing slide markup.

Another pragmatic step has been the application of the tool MindManager. Our primary interest in this particular product does stem from its ability to explicitly structure the material as a visual mind map and to transform this hierarchical structure into different presentation formats. It is straightforward for authors to create Web presentations with a complex navigation structure based on HTML documents by using the standard export functions of the tool. We have been able to generate a complete course documentation and to import it into the WebCT platform within minutes. For this, the MindManager HTML export start page was linked to the WebCT course and, instead of the content navigation provided by WebCT, students were able to use the sophisticated structure generated by MindManager. Another important feature is the export to RTF formatted word processor content which we used, after some fine-tuning of the layout using WinWord, to create PDF documents for printable scripts.

Even though the cross-media publication with MindManager is rather useful, it is not entirely satisfying. One main disadvantage is that text added to the branches of the mind map has a

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1 http://www.w3.org/XML/
determined layout which is not easy to change afterwards. For use in classroom presentations, we had to write the text in a large format. An automatic adaptation to a different style is not possible, which is in particular problematic in large-scale course projects with several authors.

In the Swiss Virtual Campus OPESS\(^2\) project, we are collaborating with authors from several Swiss universities. Here, blending the content provided by several authors into a single, uniform course is a key requirement. Furthermore, the modularity of course components and adaptability to future learning management systems are particularly important issues. To achieve these goals, we employed the XML-based Learning Material Markup Language (LMML)\(^3\) which provides appropriate markups for the structuring of learning contents. Thus, XML sources produced by different authors quite easily integrate with each other and, by using common XSL style sheets, a consistent layout is guaranteed. Moreover, once contents are available, they may be reused in different contexts, if all the necessary elements and attributes are provided. Currently, the course material of one of our advanced courses is also based on LMML-structured content.

Even though the use of XML-documents allows for very flexible solutions, it must be said that this markup language is nothing else than a structuring format and provides in itself neither a solution for the authoring process nor for the representation of contents. The practical utility of using XML for structuring E-Learning content depends on the supporting mechanisms and tools. In particular the availability of adequate authoring tools is crucial. Widespread office authoring tools are not (yet) supporting this upcoming Web standard. As common XML editors are rather complex development environments, available tools still lack a user-friendly interface which hides satisfactorily the complexity of XML writing from less technical-minded authors.

**CONCLUSIONS AND OUTLOOK**

Web-based learning environments are increasingly employed to suit the needs of students. The availability of Web-based documentation formats is an important aspect of E-Learning. Seeing that the online publication of learning materials over the Web will not in the near future replace traditional forms of course documentation, publishing tools will have to support both traditional and new (Web) publication channels. In terms of structure, multi-media means heterogeneity and hence complexity in order to maintain integrity of learning objects and learning paths. In terms of cost, increased complexity calls for more coordination and more tools, if the multiplication of media has to be handled with the same authoring resources. While in the single-author case, office tools supporting HTML export may be adequate, learning content management systems supporting the upcoming XML standards are the tools of choice for complex, multi-author projects. Proximity to the web publishing technology as well as supplier and technology independence are advantages of XML-based solutions, which will probably dominate tomorrow’s authoring and publishing systems. Though, providing an adequate tool environment is a critical success factor for the usability of XML-based E-Learning content and currently poses a considerable challenge.
