

Do-IT: from a didactic experiment to an authoring toolbox

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This article reports on a successful attempt to let students act in the roles of tool developers and tutors in e-learning.

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1. Introduction

In the current discussion about e-learning scenarios, a distinct role allocation has been established: authors create content, teachers use this content during their courses, tutors support the accomplishment of the latter. Students are seen as consumers profiting from the wide range of different possibilities provided to support the acquisition of knowledge and skills.

Often, this also applies to computer science students. However, during their studies they should learn and mature techniques to develop and elaborate e-learning tools. In many cases their subject of study is also the tool to convey this knowledge. So why not let those students switch temporarily from their role as a consumer to that of a producer?

This idea led to a number of smaller projects in software development, implemented by students of the Women's International Degree Programme "Computer Science" (IFI) at the University of Applied Sciences in Bremen [1]. These projects eventually resulted in a larger project which was supported by the Siemens AG from 2004 to 2006.

2. The idea behind Do-IT

IFI, the only single gender education in computer science in Germany, was established in 2000. Its main goal is to provide to women a well-rounded education in computer science in a supportive learning atmosphere. The training is comprised of a compulsory semester abroad and an internship, as well as group and project activities. During those projects students created a number of tools for simulation and demonstration purposes to illustrate learning matters to their fellow students. In addition, students of the higher semesters regularly act as tutors to those in their first and second semesters.

A number of courses focus on how to develop web applications, among them a module dedicated to teaching techniques for the development of distributed applications. Since these kinds of courses are offered worldwide the subject is perfect for communication across country borders. The idea arose to revise existing learning material with the help of the students and to provide and reuse it in a more flexible way, including multilingual versions of the content.

Moreover, the realisation of this project in cooperation with teachers and students at international partner universities seemed ideal to enhance the professional exchange with colleagues abroad.

To ensure the lasting usability of existing solutions, it proved necessary to integrate all material – in different layouts if needed – into the partner universities' learning management systems (LMS). A data modelling language which is already a subject of the courses mentioned above seemed particularly appropriate: XML.

3. The Do-IT toolbox

The tool development within the Do-IT project [2] is accomplished using an XML based language. By means of this language e-learning content can be described and augmented with metadata. A collection of tools has been developed for acquiring and processing this e-learning content. Figure 2 provides an overview of all tools created so far. They will be described in detail below.

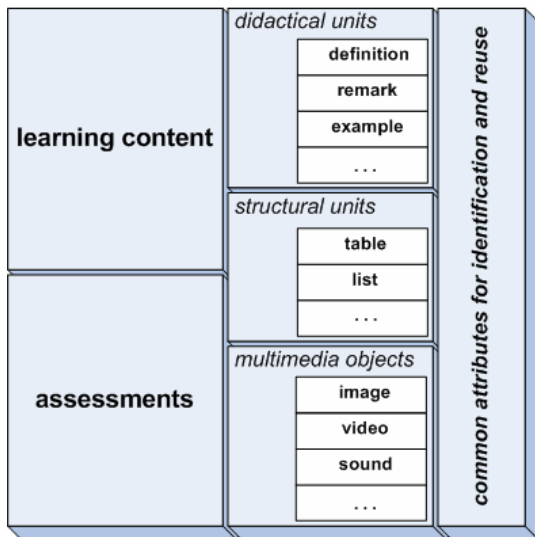


Fig. 1 *Do-IT language*. The Do-IT language allows the use of multimedia content including question and test as well as the augmentation with metadata.

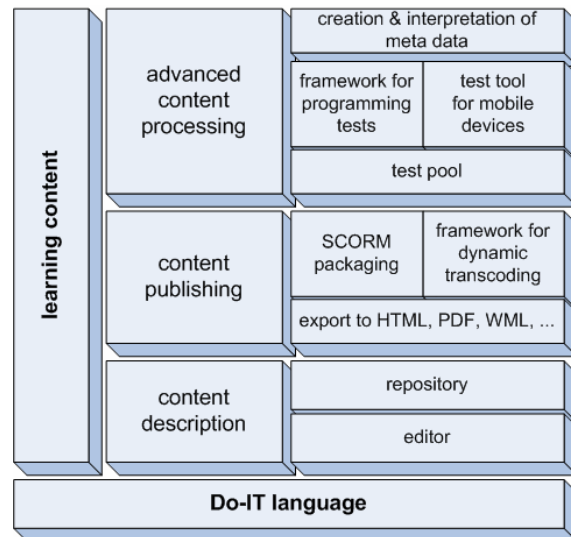


Fig. 2 *Do-IT tools*. Based on a language to describe e-learning content, various tools evolved to support the acquisition, the processing, and the use this of content.

3.1 Do-IT Language

The Do-IT language for the description of e-learning content is based on XML. It was developed taking into consideration the recommendations made by the IMS Global Learning Consortium [3]. The language enables learning content to be enriched by multimedia, exercises, and self tests tailored to different target groups as well as to different output formats. An overview of the language components is provided in Figure 1.

Apart from the description of multimedia objects (e.g. text, images, video, sound) and structural elements (such as tables, lists, etc.) the language can also be used to express didactically relevant aspects (e.g. definition, remark, example). Furthermore it provides various ways to add metadata respecting LOM standards [4]. Some of the attributes defined in the XSD specification may be assigned to more than one element. They describe metadata and scalability information such as target group or medium.

The XML based content, meaning multimedial, didactical, and structural objects, as well as learning units containing these objects is stored in self-contained data objects. Equipped with metadata they can easily be managed in a repository.

3.2 Content description and publishing

Even though the creation of Do-IT documents can basically be carried out with any editor, the students created a development environment to support authors during content creation. Do-IT documents may be converted into various final documents (e.g. HTML, PDF, WML) according to the intended use, and assembled via a SCORM packager [5], ready to be imported into a SCORM compatible learning management system (LMS).

The editor inside this development environment is highly configurable. It particularly supports the automatic completion of standard metadata values which may be modified later. It also provides convenient editing of those metadata that cannot be determined automatically. The development environment was originally created to develop Do-IT compliant documents. However its modular architecture may easily be configured to apply to similar language definitions. Do-IT documents created with the help of this development environment may be managed in a common repository enabling further processing and use.

Optimizing learning content for different devices such as desktop or portable computers, or mobile phones often requires substantial additional authoring effort. The same applies if SCORM compliant packaging is required to be able to import content into an LMS. The use of XML as a media-independent format for data management and processing enables adaptation of existing content to different usage requirements.

In the scope of Do-IT a platform for effective dynamic cross-media publishing of multimedia-based learning content has been developed [6]. This complex server-side processing of XML based documents along with the automatic transcoding into various final formats is supported by the XML publishing framework Apache Cocoon.

As a result, learning content is dynamically generated and published whereby both the content and structure, as well as the design and the document format are perfectly adapted to the needs of end users and their devices.

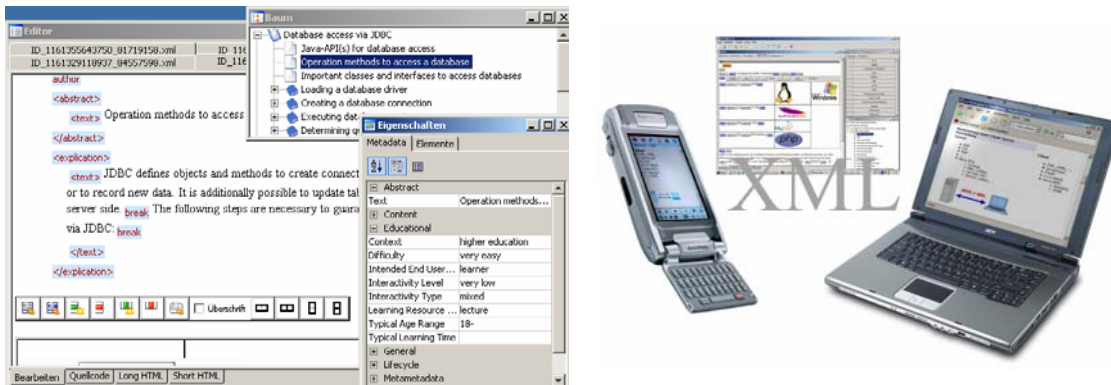


Fig. 3 *Do-IT Authoring.* An integrated development environment supports the creation of content descriptions including integration of multimedia content. In addition, it offers a dynamic transcoding for optimal use on different devices as well as an either automatic generation or an interactive input of metadata.

3.3 Advanced content processing

Apart from the presentation of learning material, different kinds of assessments promote success in e-learning. They range from self-assessments offering help in solving them to assessments tests on particular chapters of the course to online exams [7].

While assessment items may be described independently of their future use, compiling them into different kinds of assessment tests should be as easy as possible. An interactive tool meeting those requirements resulted from a diploma thesis [8]. With the help of this tool descriptions of assessment items may be extracted out of Do-IT compliant documents and integrated into an assessment pool. In addition, the tool may also be used to interactively select and assemble assessment tests in a convenient way.

Based on J2ME, a special solution was created for also taking assessment tests on mobile devices. The tool acts as an interpreter for assessment descriptions generated from existing Do-IT content and optimized according to the requirements of those devices. The resulting assessments may be consulted either online or offline.

Initially the Do-IT team mainly focused on the implementation and use of assessment types according to IMS recommendations [7]. To specifically support education in computer science, it then proved imperative to complement those standard types by special techniques and procedures to review programming assignments. Therefore a framework for those reviews was developed [9]. Different testing tools such as JavaC, Checkstyle [10], JUnit [11], and Simian [12] are integrated into this application which automatically performs those tests giving feedback on the quality of the source code. The framework is successfully used since summer term 2006 and is now being adapted for further use.

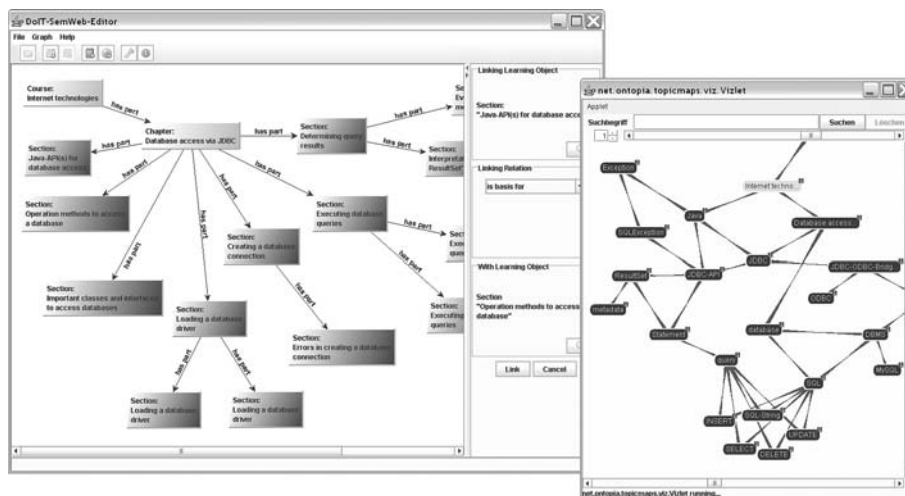


Fig. 4 Metadata creation using Learning Object Structure Petri Nets and Topic Maps.

Another diploma thesis was dedicated to the acquisition and maintenance of metadata. To manage structural dependencies between learning objects the latter are linked within Learning Objects Structure Petri Nets [13]. This special type of Petri nets helps to create metadata according to the IMS LOM recommendation regarding the relations between learning objects. It supports the author during the creation of a learning module and provides a means to the students to discover their individual learning paths. The extraction of keywords out of those learning objects and their associations inside a topic map visualize semantic relations between them. Students are provided with an overview of concepts and terms and how

those relate to each other. In addition, those keywords may also be used to cover other metadata fields such as the list of keywords.

Only little effort is required to create both the Learning Objects Structure Petri Nets and the topic maps while high-value information is gained from it: metadata about dependencies between learning objects, as well as utilities to discover individual learning paths and to gain terminology overviews.

Figure 4 shows the application for creating Learning Objects Structure Petri Nets – to be seen in the background. For the sake of simplicity, they are not visualized using the Petri net notation, but an intermediate format. The foreground shows the topic map created out of the terms extracted from the same learning objects. An additional exploration tools lets students browse those two structures.

Detailed information on this work may be found in [14].

4. Conclusion

The development of e-learning components in the scope of student research projects was recognized as being extremely fruitful in IFI.

The students become familiar with advanced technical developments to actively improve their own learning environment. Furthermore they are expanding their knowledge by preparing content for their fellow students.

High motivation and interest in contributing to this project were recognized since the resulting tools would directly be used when the students returned from being developers to being students.

Some issues often discussed in e-learning such as effective content creation and metadata collection were directly experienced by the students. They developed a certain awareness that influenced the tool conception. Those learning effects were enforced by them, again, covering different roles. Their motivation carried over to younger students getting in touch with the project and its results.

Selected subprojects are now continued as dissertation projects.

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