



Improving the Virtual Learning Development Processes Using XML Standards

KURT SÜSS & THOMAS OBERHOFER*
Universität Erlangen

AUSTKACT

Distributed learning environments and content often lack a common basis for the exchange of learning materials. This delays, or even hinders, both innovation and delivery of learning technology. Standards for platforms and authoring may provide a way to improve interoperability and cooperative development. This article provides an XML-based approach to this problem created by the IMS Global Learning Consortium.

KEYWORDS: Distributed learning environments, exchange of learning materials. IMS Global Learning Consortium, XML, XML-based approach.

* *Address for correspondence:* Dr. Kurt Süß, Leiter der Abt. Romanische Sprachen II, Sprachenzentrum der Universität Erlangen, Bismarckstr. 1, D-91054 Erlangen, e-mail: ktsuess@phil.uni-erlangen.de. Thomas Oberhofer, Sprachenzentrum der Universität Erlangen, Bismarckstr. 1, D-91054 Erlangen, e-mail: th.oberhofer@phil.uni-erlangen.de.

I. INTRODUCTION

In the meantime, the digitalization of education materials has been advancing for some years and its necessity has been ubiquitously propagated. In fact, systems and materials for virtual teaching have been developed by corporations, universities and government agencies around the world since then. Aside from that, one can find a large number of more or less systematically constructed and maintained content on the Internet. For many involved in education the use of these resources became an integral part of their daily work routine.

Potential users of educational contents, however, whether they be students or teachers, often see themselves, in using the new technology, confronted with significant obstacles: every virtual learning environment follows its own understanding of the "correct" usability; the materials are often adapted to fit the lesson plans and needs of the respective providers and don't cover the requirements of third parties; file formats, such as PowerPoint and Flash applications, make it difficult to directly access parts of more extensive contents pertaining to one's own purposes. The list goes on.

II. TEACHING UNITS USING THE BUILDING BLOCK PRINCIPLE

If one considers these aspects together with the substantially higher effort in creating a virtual lecture hour, in comparison to conventional lectures, the demand for the reusability of digital teaching units, for the use of synergy and coupling effects, and for the disaggregation of complexly structured virtual lectures and seminars is not only understandable but also justified. The goal would be the efficient and effective compilation of digital teaching units using the building block principle.

Are such building blocks conceivable and how should they be constructed? An important feature would be file formats, which—if possible, platform independent—are not subject to limitations such as the above mentioned PowerPoint and Flash formats and support built-in mechanisms for structuring the contents, or rather the direct access to parts of documents. Moreover, information for interactive contents, such as exercises and simulations, should be codable in the document itself. Standards in the form of "templates", which take all criteria for the realization regarding content and didactic into consideration, are desirable for the support of the interchangeability of the materials and their efficient production. The same goes for problems with character sets which should especially be considered regarding foreign language training material. Application software for the creation and delivery of virtual teaching and learning units should again optimally support and transparently implement the developmental process.

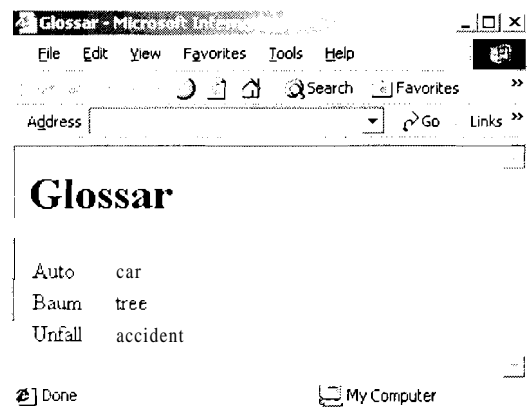
III. FLEXIBILITY AND PLATFORM INDEPENDENCE THROUGH XML

For a few years now the extensible Markup Language (XML) has presented itself as a solution for a flexible and platform independent production of digitized material. XML was introduced in 1996 with the goal of replacing HTML on a long-term basis as the *Lingua Franca* of the Web. HTML is a less flexible mix of directives for the structuring and presentation of documents — a large part of the HTML-elements, such as <H1>, <H2> and , serve to control the layout. In contrast to this, XML has some significant advantages: separation of structure, content and layout, the determination of markup elements — more specifically, its own Document Type Definition (DTD)—, mechanisms for the direct access to parts of the document, Unicode support and more.

The difference between HTML and XML becomes clear in an example from a simple glossary. The corresponding HTML-code (without header) could look like the following:

```
<body>
<h1>Glossar</h1>
  <p>
    <table>
      <tr>
        <td>Auto</td>
        <td>car</td>
      </tr>
      <tr>
        <td>Baum</td>
        <td>tree</td>
      </tr>
      <tr>
        <td>Unfall</td>
        <td>accident</td>
      </tr>
    </table>
  </p>
</body>
```

A Web-Browser displays these lines as in the following picture:



While only the determined directives are valid in the HTML-document, XML enables the insertion of its own markup elements such as `<Glossary>`, `<Entry>`, `<German>`, `<English>`, omitting any layout information and, moreover, — in contrast to the abstract HTML-elements `<tr>` (table row) and `<td>` (table data) — allows conclusions of the information provided. And the glossary as an XML-Document (without header) looks like this:

```
<Glossar>
<Titel>Glossar</Titel>
<Eintrag Id="1">
  <Deutsch>Unfall</Deutsch>
  <Englisch>accident</Englisch>
</Eintrag>
<Eintrag Id="2">
  <Deutsch>Auto</Deutsch>
  <Englisch>car</Englisch>
</Eintrag>
<Eintrag Id="3">
  <Deutsch>Baum</Deutsch>
  <Englisch>tree</Englisch>
</Eintrag>
</Glossar>
```

The eXtensible Stylesheet Language (XSL) is used for displaying XML documents. It provides the functions and rules for the presentation of the XML elements. Not only can these mechanisms process XML documents for presentation in a Web browser as in the above example, but also for the output in many other formats such as the Portable Document Format (PDF). Moreover, the possibility exists, with the help of the XSL Stylesheets, to directly display parts of documents, while HTML-files must be completely loaded.

IV. STANDARDIZATION EFFORTS

The advantages, in particular which XML has over HTML in processing large numbers of similar documents, cannot only be used for glossaries, but also for interactive exercises, regional studies, grammar, etc..

The strength of the approach could, however, turn itself around if those involved in the production of teaching materials create "isolated solutions" in the form of their own XML document type definitions. The effort in adjusting foreign documents to insert in one's own environment is significant and, in terms of the mutual use of resources as in the context of virtual universities, uneconomical.

Given these problems, several organizations, such as the IEEE Learning Technology Standardisation Committee, the Advanced Distributed Learning (ADL) Initiative, the Aviation Industry CBT Committee (AICC) and the ISO/IEC JTC1 SC36 Learning Technology, have gone to trouble of getting standardizations in the area of virtual learning in the past. The IMS Global Learning Consortium, Inc. (IMS) is pursuing an additional, more promising approach. The members of the non-profit organization include, among others, a series of well-known companies, universities, and government agencies, such as Apple, IBM, Microsoft, Oracle, Massachusetts Institute of Technology (MIT), and the Open University in the Netherlands. IMS is speeding up the development and promotion of open XML-based specifications, which should specifically support activities in the field of distributed on-line learning, such as, for example, finding and using learning materials or the assessment of the progress and performance in one's studies.

- The *Question & Test Interoperability Specification (QTI)* describes a basic structure for the representation of Item and Assessment. The specification enables the exchange of this test, assessment and results data between Learning Management Systems, as well as content authors and, content libraries and collections. It is extensible and customizable to allow for the immediate adoption, even in specialized or proprietary systems.
- The *IMS Content Packaging Specification* provides the functionality to describe and package learning materials, such as an individual course or a collection of courses, into

interoperable, distributable packages. Content Packaging addresses the description, structure, and location of online learning materials and the definition of some particular content types. The Content Packaging Specification is aimed primarily at content producers, Learning management system vendors, computing platform vendors, and learning service providers. Learning materials described and packaged using the IMS Content Packaging XML format should be interoperable with any tool that supports the Specification. Content creators can develop and distribute material knowing that it can be delivered on any compliant system.

- The *IMS Learning Resource Meta-data Specification* was developed to counteract the fact that the now large number of software tools for the creation of learning materials lacks a common mechanism which finds and uses the materials. A meta-data specification ensures more efficient processes in finding and using resources, in which a structure of definable, descriptive labels would be offered, which would describe, or rather, catalogue the learning resources.
- The *IMS Learner Information Package Specification* is a collection of information about learners or producers of learning contents. The specification aims at the interoperability of Internet-based Learning information systems with other systems which support the Internet learning environments. The goal of the specification is to define a number of packages which can be used to exchange data with learning information servers corresponding to the IMS-Specification.
- The *IMS Reusable Competency Definition Specification* plots out an information model to describe, to reference and to exchange competency definitions, primarily within the context of on-line and distributed learning. In this specification the word "competency" is used in a very general sense and incorporates skills, knowledge, assignments and learning results. This specification offers the functionality to formally present, independent of its use in a certain context, key characteristics of competency and to enable the interoperability among learning systems which delivers competency information.
- The objective of the *IMS Enterprise Specification* is to define a standardized set of structures that can be used to exchange data between different systems and to guarantee an integration, as optimal as possible, of training management systems in existing IT infrastructures.

V. APPLICATIONS

A simple example from the Question & Test Interoperability Specification gives the first impression of possible realizations of the specification. A true/false question without processing could be represented as an interactive exercise as follows:

Paris is the Capital of France

Agree

Disagree

The corresponding formulation in QTI-XML shows the following code excerpt:

```

1  <questesinterop
2    <qcomment
3      <b>This is a simple True/False multiple-choice example using QTI V1.0 or V1.1.
4      <b>The rendering is a standard radio button style.
5      <b>No response processing is incorporated.
6    </qcomment>
7    <item id="IMS_V01_1_BasicExample001"
8      <presentation label="BasicExample001"
9        <material
10       <matext .Paris is the Capital of France . matext
11       </material>
12       <response lid ident="TF01" cardinality="Single" timing="No">
13         <render_choice .
14           <response_label ident="T">
15             <material> .matext Agree .matext </material>
16           </response_label .
17           <response_label ident="F">
18             <material . .matext Disagree </matext> </material .
19             </response_label
20           </render_choice>
21         </response_lid
22       </presentation
23     </item>
24 </questesinterop>

```

The QTI code can be completely transparent for the user. Applications are now available (see, among others, <http://www.imsproject.org/direct/getproducts.cfm> (10.29.2001)) which implement the specification in the form of Windows-, Java-, or HTML-based applications and enable learners and authors to work in the familiar Look and Feel. Nonetheless, the products of different manufacturers can exchange test materials among themselves, since the data, as in the above example, are available in QTI-XML format. QTI distinguishes between basic response and render types, from which a total of twelve types of answers can be derived, which, in part, are again variable, or rather, combinable.

Response Types	Render Types
<ul style="list-style-type: none"> • XY co-ordinate • String • Number • Logical group • Logical identifier 	<ul style="list-style-type: none"> • Choice • Hot-spot • Fill-in-blank • Slider • 'Object'

Detailed descriptions of the outlined specification of the IMS Global Learning Consortium can be found at the following Internet address: <http://www.imsproject.org> (10.29.2001). The relationship to other standardization efforts is also discussed there.

VI. SYSTEMS

There are a number of companies and institutes which are implementing the IMS specification, or rather, parts of it (see the following URLs <http://www.imsproject.org/direct/getproducts.cfm> (10.29.2001) and also <http://www.imsproject.org/direct/getorgs.cfm> (10.29.2001)). The range of functions, supported platforms, and price models of systems differ greatly. The palette extends from Windows-based applications for smaller groups to completely web-based environments.

The in- and export of teaching units conforming to the IMS implements for example, Question Mark's Perception for Windows and Perception for Web (<http://www.questionmark.com> (10.29.2001)). The creation of the materials takes place in the very easy-to-use Windows application Perception for Windows. At the same time, the creation of interactive contents is supported by Wizards and a variety of exercise types are offered. A database, included in the application, administers the teaching elements and also supports the creation of teaching elements in teams. The authors can test the results of their work in a preview window.

Editing What is the capital city of the Philippines?

File Edit View Question Help

Question

- What is the capital city of the Philippines:
- Question Type: Multiple Choice
 - Choice 0 - Manila
 - Choice 1 - Jakarta
 - Choice 2 - Seoul
 - Choice 3 - Taipei
- Outcome: 0 Manila Score: 1 Feedback Y
- Outcome: 1 Jakarta Score: 0 Feedback.
- Outcome 2 Seoul Score 0 Feedback N
- Outcome 3 Taipei Score 0 Feedback N

Question Mark Perception

these questions

Score so far: 1 out of 1, 100%

Score for these questions: 1 out of 1, 100%

1 of 1

What is the capital city of the Philippines?

- Jakarta
- Taipei
- Seoul
- Manila

1 out of 1

Yes, Manila is the capital.

Continue

Supplementary to Perception for Windows, the component, Perception for Web, permits the contents to be offered in the Internet. The elements previously developed under Windows do not need to be worked on any further for that. In addition, courses, course participants and instructors can be set up and managed through Perception for Web. Report functionalities allow for the assessment of learning progress and test results.

In the realm of Open Source, the Integrated Learning, Information, and Cooperation System (ILIAS) of the University of Cologne (see this address: <http://www.ilias.uni-koeln.de/ios/index.html> (10.29.2001)) and the Open Knowledge Initiative of the Massachusetts Institute of Technology (<http://web.mit.edu/oki/> (10.29.2001)) are backing the specifications of the IMS Global Learning Consortiums. While OKI is still in the planning stages, ILIAS is already available in Version 2.x. The latter is an efficient, completely web-based client-server-system that offers tools for authors, personalized learning environments, administration tools as well as communication and collaboration tools.

VII. CONCLUSIONS

XML-based specifications for virtual learning environments are in a comparatively early stage of development. As in the case of other standardization efforts, some changes and augmentations are still to be expected. The involvement on the part of renowned manufacturers and education institutes suggests, however, that great importance is given to these types of standardization efforts.

The interchangeability of learning materials and their more efficient production, together with improved accessibility, communicate attractive features of this development. One's own experiences, which could be gained within the scope of XML-based projects for the creation of language learning materials, have been entirely positive. The cost of the development of language learning materials was not only reduced by the separation of content and layout, or functionality; the project contributors realized that the quality of the materials was also improved. Two aspects seem to complement each other in this respect: first, it was possible for the authors to observe the developed XML-contents from the learner's perspective at any time and to be able to appropriately assess its appearance. Secondly, the XML-DTD, though developed for the learning application but, nevertheless, restrictive, removed the burden from the authors of all the questions concerning the layout and other problems which usually come up when creating HTML sites. Even the predefined document structure considerably improved the concentration in didactic and content of materials.

The question remains if it would be possible for smaller organizations to come up with enough financial and personnel resources for the operation of such client-server-systems.

Particularly in the university arena, a national approach with a central system management and user support would be conceivable and wise/practical.

LINKS

<http://www.imsproject.org>

The IMS Global Learning Consortium —provides XML-based specifications for E-Learning systems

<http://www.imsproject.org/direct/getproducts.cfm>

Directory of Products and Organizations Supporting IMS Specifications

<http://www.imsproject.org/direct/getorgs.cfm>

Directory of Products and Organizations Supporting IMS Specifications

<http://www.questionmark.com>

Questionmark — a company developing IMS-compatible products

<http://www.ilias.uni-koeln.de/ios/index.html>

ILIAS —an open source learning management system, which implements features for IMS compatibility

<http://web.mit.edu/oki/>

The Open Knowledge Initiative (OKI) is defining an open architectural specification to be used for the development of educational related software.