ELML, THE E-LESSON MARKUP LANGUAGE

Developing Sustainable e-Learning Content Using an Open Source XML Framework

Joël Fisler
Geography Department, University of Zurich, Winterthurerstrasse 190, 8057 Zurich, Switzerland

Susanne Bleisch
Basel University of Applied Sciences (FHNW), 4132 Muttenz, Switzerland

Keywords: e-Learning, XML, open source, sustainable content, Internet, web, SCORM, IMS, education, eLML.

Abstract: eLML, the open source "eLesson Markup Language", is an XML framework allowing authors of e-Learning lessons to create structured and sustainable content. eLML is based on the pedagogical concept ECLASS (adapted from Gerson, 2000), standing for entry, clarify, look, act, self-assessment and summary. Each lesson is divided into units that contain a number of smaller learning objects. To allow different teaching and learning scenarios most of the structure elements are optional or can be repeated several times and in different orders. Lessons written with eLML can be transformed into HTML or PDF or be imported into a learning management system (LMS) using the SCORM or IMS Content Packaging format. The paper presents experiences from the development of eLML itself, the design of e-Learning content based on the eLML-structure, and the use of eLML-based content in conjunction with a LMS.

1 INTRODUCTION

eLML was developed by the Swiss e-Learning project GITTA (Fisler, 2004), a modular online course in Geographic Information Science and Technology. Within the GITTA project nearly forty authors from ten partner universities created around fifty lessons and ten case studies. The heterogeneous and multilingual consortium needed strict pedagogical and technical guidelines to create consistent lessons with the same look and feel. After an extensive evaluation of existing tools and learning management systems (LMS) – back in 2001 most LMS used proprietary formats and there have been many projects using such tools and losing their content after a LMS' development was discontinued due to the lack of export possibilities – the project coordinators agreed in 2001 to use XML for the technical implementation and base it on the pedagogical model ECLASS (Gerson, 2000). Thus, the lessons can be checked and validated for certain rules and restrictions by a XML Schema and therefore all authors must create identically structured lessons.

The launch of eLML came only after the official ending of the GITTA project when the Swiss Virtual Campus discovered the potential of GITTA's XML structure. With minimal funding a consolidated, server-independent and well-documented XML framework based on XML Schema was developed in spring 2004. This updated GITTA XML structure was named eLML, the eLesson Markup Language (Fisler et al., 2004) and was published as an open source project under the General Public License (GPL) on Sourceforge.net. Since then a constantly growing number of projects and authors in Switzerland and Germany have started using eLML as their tool for creating e-Learning lessons. At the University of Zurich and the University of Applied Sciences Northwestern Switzerland eLML has become the main XML framework for creating and maintaining e-Learning content, a fact that ensures that further funding and developing skills are put into the enhancement of eLML.

Fisler J. and Bleisch S. (2006).
ELML, THE E-LESSON MARKUP LANGUAGE - Developing Sustainable e-Learning Content Using an Open Source XML Framework.
In *Proceedings of WEBIST 2006 - Second International Conference on Web Information Systems and Technologies - Society, e-Business and e-Government / e-Learning*, pages 180-187
DOI: 10.5220/0001254701800187

2 PEDAGOGICAL CONCEPT

The aim of eLML was to offer authors a tool that ensured conformity to pedagogical guidelines. These guidelines were adapted from the ECLASS model developed by Gerson (2000). ECLASS is an acronym for the terms entry, clarify, look, act, self-assessment and summary. Together with additional important elements like glossary, bibliography and metadata, the ECLASS elements build the main structure of the XML framework eLML. The different elements allow the creation of a pattern of learning experiences helping people to learn effectively and efficiently (Horton, 2000).

As shown in Figure 1, lessons are organized into different modules that again are part of a complexity level. Levels and modules are purely organizational entities with no technical relation within eLML. In eLML, lessons are the smallest interchangeable entities. A lesson is built from units (conforming to the ECLASS model) and of additional elements like learning objectives, bibliography, glossary and metadata.

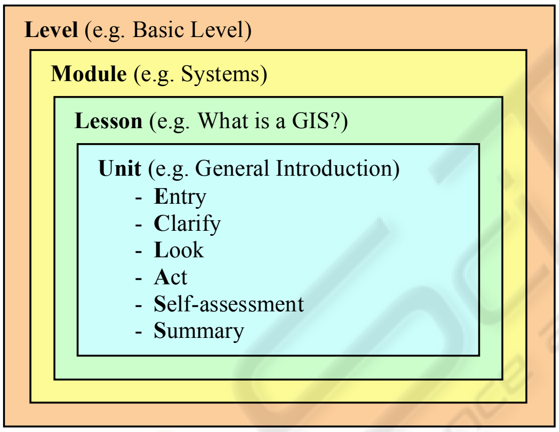

Level (e.g. Basic Level)
Module (e.g. Systems)
Lesson (e.g. What is a GIS?)
Unit (e.g. General Introduction)
- **E**ntry
- **C**larify
- **L**ook
- **A**ct
- **S**elf-assessment
- **S**ummary

Figure 1: ECLASS model adapted from Gerson.

eLML is not as rigid as it may look. Since some elements are optional (see Figure 2) or can be used in reverse order, it is flexible enough to allow the representation of different e-Learning scenarios such as the following:

– **Lessons:** Standard e-Learning lessons begin with an entry element that describes the context or the content of the lesson. They could continue with a clarify element explaining the theory and either one or more look elements to show examples or an act element where the students are invited to try something by themselves. Usually lessons end with a self-assessment to check if the learning objectives are reached and a summary.
– **Case studies:** As Niederhuber (2005) describes, GITTA case studies use their own didactical model but are nevertheless implemented in eLML. They usually start with an entry element followed by two units (using clarify elements), where the clarify elements are used to describe the instructions and not to explain theory.
– **Other Forms:** Another project uses eLML to document and generate structured reports. In this case, elements such as act and self-assessment elements are not used. The GITTA project even uses eLML to create its public website.

3 THE STRUCTURE OF ELML

The described pedagogical model ECLASS is mapped onto an XML structure using XML Schema:

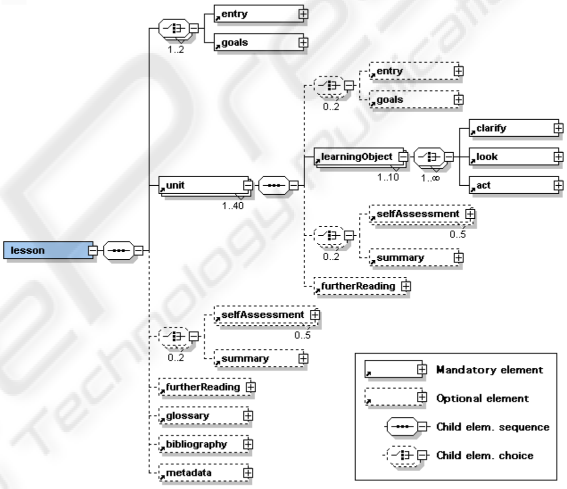


Figure 2: Top level structure of eLML.

An eLML lesson always starts with either the mandatory introduction (element entry) or a concise listing of the lessons learning objectives (element goals). The unit elements, described below, contain the actual content of a lesson. Following the units a lesson can have a summary and/or up to five self-assessments followed by an optional further reading and glossary section to list important resources and to describe terms used within the lesson. The XML Schema ensures that all glossary terms used in a lesson are defined in the glossary. The APA (2005) or the Harvard Citing System (Holland, 2004) can be used for the bibliography. All citations, references, further readings etc., have to be listed within the bibliography section, otherwise the XML parser issues an error and the lesson will not be valid.

Using mandatory elements eLML ensures that at least the minimal metadata elements are filled out even though many authors do not like to fill in metadata information. The eLML metadata elements are a subset of the IMS LOM "Learning Resource Metadata Specification" (2002) and can be used to store data about the length of the lessons, the author(s), copyrights, the required knowledge to work through the lesson and the basic technical requirements. The bibliography style elements and the metadata section are defined in a separate XML Schema and thus can be replaced by other standards or definitions.

Within each unit a similar structure as the one on lesson level is employed. However, the elements glossary, bibliography and metadata are always defined for the whole lesson only and not repeated on unit level. The actual content within a unit is stored in a number of so-called "learning objects" (not to be confused with the learning objectives, called "goals" within eLML). Each learning object describes a certain concept, model, equation, term, or process using the three elements clarify (theory), look (example) and act in free order. These three elements can have a special visual representation when transformed into a presentation format – e.g. a "gear" icon for act elements is used in GITTA to signal to the student that they have to "do" something – but their main purpose is to guide authors while creating content. Using the elements clarify, look and act, the author has to think about how a certain concept can be presented best to the student. Whether a learning object starts with some theory (clarify element) and continues with one or more examples (look elements) or, alternatively, the student first has to do something (act element) and then reads the theory afterwards (clarify element) is left to the author. Especially the element act should remind the authors that effective learning is active learning (Horton, 2000) and that exercises, projects and other individual and group work should be included into lessons. A learning object typically fits on one or two screen pages and takes the student about five to ten minutes to understand. But the total length or required working time for a lesson is not defined within eLML. Some projects use one eLML lesson per two-hour classroom lesson; others represent a whole semester course in one lesson.

3.1 Structuring the Content

The last section covered the basic structure of an eLML lesson. The mentioned structural elements, entry, unit, learning object, self-assessment, summary etc., can be looked at as lesson chapter titles. Within these chapters, there are content elements that contain the actual text, multimedia elements, and so on.

The old GITTA structure employed semantic elements like, for example, explanation, remark or motivation paragraphs. The authors rejected this approach, as the usefulness of such elements was not obvious. Additionally, most of those elements were visually represented the same way when transformed into a presentational format. If they were displayed differently, then the authors selected the paragraphs according to their final appearance and not because of the semantic meaning. In theory, a total separation between content and representation (layout) would be desirable but – as the GITTA project showed within its three years – this is not realistic. Therefore certain structural elements (column, formatted, newLine etc.) are offered within eLML to meet the basic needs of the authors. The following list describes the eLML content elements:

- *column:* Defines a two- or three-column layout.
- *table:* For tables and not as a layout element.
- *list:* Numbered or bulleted lists.
- *box:* Content is represented in a box. The exact layout of boxes is defined in a separate CSS file.
- *term:* Using a glossary term the definition is either appears as "mouse over" layer with a link to the glossary or as a separate paragraph.
- *newLine:* A short or long line break.
- *multimedia:* Pictures, Flashes, Applets, Movies, SVG or even plain HTML code (e.g. JavaScript).
- *formatted:* Possibility to format text as bold, italic, underlined, subscript etc. or use CSS code.
- *popup:* Clicking on the question opens a box with an answer.
- *link:* Link to external or internal resources including other units, learning objects etc.
- *citation:* Can be inline or as a paragraph with many options described in the manual. The cited resource has to be defined in the bibliography!
- *paragraph:* Regular paragraph with attributes like; being visible only to tutors, displayed only in the print or online version of a lesson, etc.
- *indexItem:* Marks words to be listed in the index.

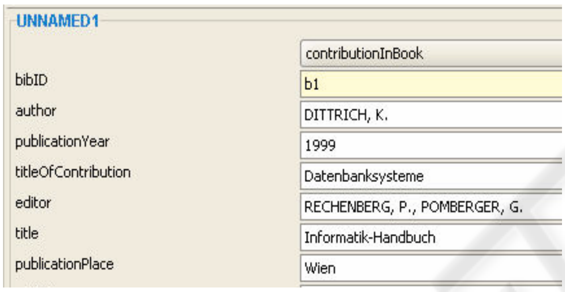
All of these elements have additional attributes like role (tutor/student), visibility (online/print), class (remark, important, etc.) and others parameters described in detail in the manual. eLML also defines rules for the nesting of elements. For instance, to include a column within a list element would not make sense, neither would a table within a multimedia element. Therefore the XML Schema exactly defines which element can be used where.

3.2 Authoring Tools

Creating an eLML lesson typically starts with defining the learning objectives of a particular lesson (the "goals" element). When the author has defined what the student should learn from a lesson, they then decide on the units that are needed to present the subject matter and define learning objects that present a certain aspect of the topic. The actual writing of the lesson is usually done with an XML editor. Multimedia elements like movies or flash animations etc. are made using the appropriate tools. To facilitate the use of eLML for authors not familiar with XML two promising solutions are in progress.

The University of Zurich is currently developing an eLML authoring tool that will be integrated into a content management system and allows simple editing of eLML lessons using a standard web browser. This authoring tool should be available in late 2006.

Another solution is to use tools that can render a Graphical User Interface (GUI) based on an XML Schema like, for example, JAXFront (2001). It was tested with eLML and is able to simplify the maintenance of lessons enormously.



UNNAMED1

	contributionInBook
bibID	b1
author	DITTRICH, K.
publicationYear	1999
titleOfContribution	Datenbanksysteme
editor	RECHENBERG, P., POMBERGER, G.
title	Informatik-Handbuch
publicationPlace	Wien

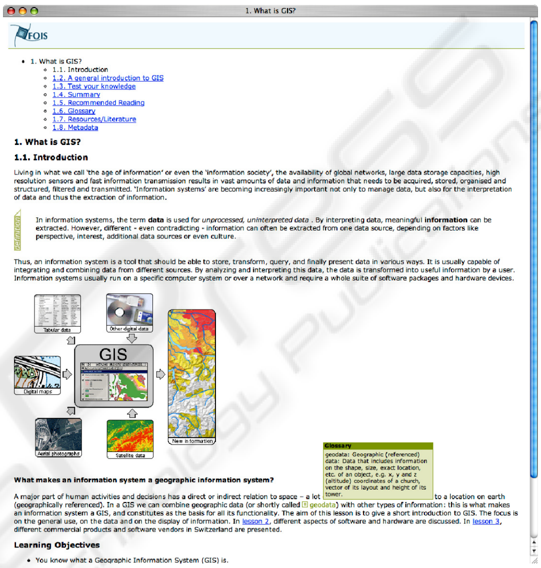
Figure 3: JAXFront renders a GUI based on an XMLSchema.

4 PRESENTATION

eLML includes files for transformation of XML lessons into both an online (HTML) and a print (PDF) version. A third output option for mobile devices and PDAs is under construction. The following sections will cover the different formats supported by eLML. This chapter also shows the advantage of separating the presentation from the content, as it is done with XML in general and therefore also with eLML. While the content can be updated to reflect the current knowledge about a subject, the presentation can be updated within seconds by simply re-transforming the lessons. On the other hand it is possible to do the transformation of a lesson several times with different transformation scripts and thus get different output formats or styles.

4.1 Online (HTML)

The author of a lesson can choose between different built-in layout templates or create their own template. The standard transformation file of eLML produces clean XHTML 1.0 code including many CSS classes for boxes, tables, goals etc. The following screenshot shows a lesson where the author only adapted the according classes in the CSS file and did not need any knowledge of HTML or XML at all:



- 1. What is GIS?
  - 1.1. Introduction
  - 1.2. A general introduction to GIS
  - 1.3. Test your knowledge
  - 1.4. Summary
  - 1.5. Recommended Reading
  - 1.6. Glossary
  - 1.7. Resources/Literature
  - 1.8. Metadata

1. What is GIS?

1.1. Introduction

Living in what we call 'the age of information' or even the 'information society', the availability of global networks, large data storage capacities, high resolution sensors and fast information transmission results in vast amounts of data and information that needs to be acquired, stored, organised and structured, filtered and transmitted. 'Information systems' are becoming increasingly important not only to manage data, but also for the interpretation of data and thus the extraction of information.

In information systems, the term **data** is used for *unprocessed, uninterpreted data* . By interpreting data, meaningful **information** can be extracted. However, different - even contradicting - information can often be extracted from one data source, depending on factors like perspective, interest, additional data sources or even culture.

Thus, an information system is a tool that should be able to store, transform, query, and finally present data in various ways. It is usually capable of integrating and combining data from different sources. By analyzing and interpreting this data, the data is transformed into useful information by a user. Information systems usually run on a specific computer system or over a network and require a whole suite of software packages and hardware devices.

Glossary

geodata: Geographic (referenced) data: Data that includes information on the shape, size, exact location, etc. of an object, e.g. x, y and z (altitude) coordinates of a church, vector of its layout and height of its tower.

What makes an information system a geographic information system?

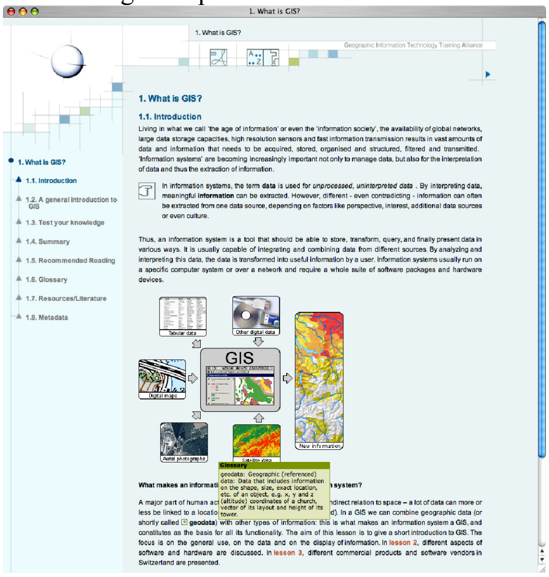
A major part of human activities and decisions has a direct or indirect relation to space – a lot to a location on earth (geographically referenced). In a GIS we can combine geographic data (or shortly called geodata) with other types of information: this is what makes an information system a GIS, and constitutes as the basis for all its functionality. The aim of this lesson is to give a short introduction to GIS. The focus is on the general use, on the data and on the display of information. In lesson 2, different aspects of software and hardware are discussed. In lesson 3, different commercial products and software vendors in Switzerland are presented.

Learning Objectives

- You know what a Geographic Information System (GIS) is.

Figure 4: Lesson presented using the FOIS project layout.

For knowledgeable authors it is possible to use XHTML to create a more sophisticated layout like the following example demonstrates:



1. What is GIS?

- 1. What is GIS?
  - 1.1. Introduction
  - 1.2. A general introduction to GIS
  - 1.3. Test your knowledge
  - 1.4. Summary
  - 1.5. Recommended Reading
  - 1.6. Glossary
  - 1.7. Resources/Literature
  - 1.8. Metadata

1. What is GIS?

1.1. Introduction

Living in what we call 'the age of information' or even the 'information society', the availability of global networks, large data storage capacities, high resolution sensors and fast information transmission results in vast amounts of data and information that needs to be acquired, stored, organised and structured, filtered and transmitted. 'Information systems' are becoming increasingly important not only to manage data, but also for the interpretation of data and thus the extraction of information.

In information systems, the term **data** is used for *unprocessed, uninterpreted data* . By interpreting data, meaningful **information** can be extracted. However, different - even contradicting - information can often be extracted from one data source, depending on factors like perspective, interest, additional data sources or even culture.

Thus, an information system is a tool that should be able to store, transform, query, and finally present data in various ways. It is usually capable of integrating and combining data from different sources. By analyzing and interpreting this data, the data is transformed into useful information by a user. Information systems usually run on a specific computer system or over a network and require a whole suite of software packages and hardware devices.

Glossary

geodata: Geographic (referenced) data: Data that includes information on the shape, size, exact location, etc. of an object, e.g. x, y and z (altitude) coordinates of a church, vector of its layout and height of its tower.

What makes an informati n system?

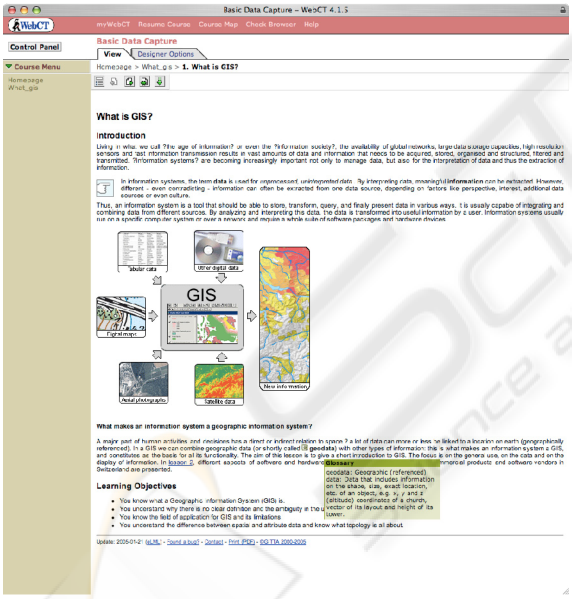
A major part of human act ndirect relation to space – a lot of data can more or less be linked to a locatio d). In a GIS we can combine geographic data (or shortly called **geodata**) with other types of information: this is what makes an information system a GIS, and constitutes as the basis for all its functionality. The aim of this lesson is to give a short introduction to GIS. The focus is on the general use, on the data and on the display of information. In lesson 2, different aspects of software and hardware are discussed. In lesson 3, different commercial products and software vendors in Switzerland are presented.

Figure 5: Lesson presented using the GITTA layout.

Furthermore an author can decide if new XHTML files should be created for each learning object or if each unit should be displayed on one page as a whole. This scenario is, for example, used for case studies that do not contain as much text as regular lessons. It is also possible to display the whole lesson on one single page. The creation of multiple pages is done by using XSLT 2.0 commands; no parser specific elements have been used. Therefore any XSLT 2.0 aware parsers support this feature.

4.2 Online (SCORM & IMS CP)

eLML supports both Sharable Content Object Reference Model (SCORM, 2004) and IMS Content Packaging (IMS CP, 2000) standards. Almost all learning management systems (LMS) available today like, for example, WebCT or OLAT, support one of these standards and therefore are able to import lessons created in eLML. The following example shows the same lesson as illustrated in the last chapter but this time imported into WebCT using the SCORM standard:



Basic Data Capture

Homepage > What_gis > 1. What is GIS?

What is GIS?

Introduction

Living in what we call ?the age of information? or even the ?information society?, the availability of global networks, large data storage capacities, high resolution sensors and fast information transmission results in vast amounts of data and information that needs to be acquired, stored, organised and structured, filtered and transmitted. ?Information systems? are becoming increasingly important not only to manage data, but also for the interpretation of data and thus the extraction of information.

In information systems, the term **data** is used for *unprocessed, uninterpreted data* . By interpreting data, meaningful **information** can be extracted. However, different - even contradicting - information can often be extracted from one data source, depending on factors like perspective, interest, additional data sources or even culture.

Thus, an information system is a tool that should be able to store, transform, query, and finaly present data in various ways. It is usualy capabe of integrating and combining data from different sources. By analyzing and interpreting this data, the data is transformed into useful information by a user. Information systems usually run on a specific computer system or over a network and require a whole suite of software packages and hardware devices.

What makes an information system a geographic information system?

A major part of human activities and decisions has a direct or indirect relation to space ? a lot of data can more or less be linked to a location on earth (geographically referenced). In a GIS we can combine geographic data (or shortly called **geodata**) with other types of information: this is what makes an information system a GIS, and constitutes as the basis for all its functionality. The aim of this lesson is to give a short introduction to GIS. The focus is on the general use, on the data and on the display of information. In lesson 2, different aspects of software and hardware [Glossary overlay] mmercial products and software vendors in Switzerland are presented.

Glossary

geodata: Geographic (referenced) data: Data that includes information on the shape, size, exact location, etc. of an object, e.g. x, y and z (altitude) coordinates of a church, vector of its layout and height of its tower.

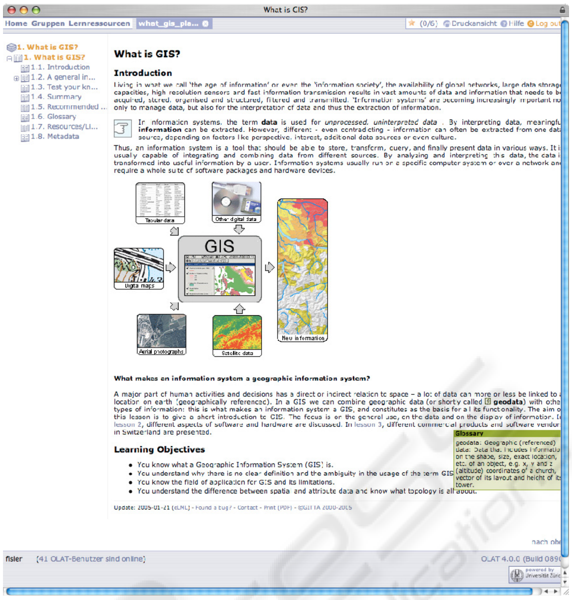
Learning Objectives

- You know what a Geographic Information System (GIS) is.
- You understand why there is no clear definition and the ambiguity in the u
- You know the field of application for GIS and its limitations
- You understand the difference between spatial and attribute data and know what topology is all about

Update: 2005-01-21 (eLML) - Found a bug? - Contact - Print (PDF) - ©GITTA 2000-2005

Figure 6: Lesson imported into WebCT using SCORM.

At the University of Zurich the main learning management system is a self-developed open source LMS called OLAT (1999) that supports the IMS Content Package standard for importing of lessons. The following screenshot shows a lesson imported as an IMS Content Package into OLAT:



1. What is GIS?
1. What is GIS?
1.1. Introduction
1.2. A general in...
1.3. Test your kn...
1.4. Summary
1.5. Recommended ...
1.6. Glossary
1.7. Resources/Li...
1.8. Metadata

What is GIS?

Introduction

Living in what we call 'the age of information' or even the 'information society', the availability of global networks, large data storag capacities, high resolution sensors and fast information transmission results in vast amounts of data and information that needs to b acquired, stored, organised and structured, filtered and transmitted. 'Information systems' are becoming increasingly important no only to manage data, but also for the interpretation of data and thus the extraction of information.

In information systems, the term **data** is used for *unprocessed, uninterpreted data* . By interpreting data, meaningfu **information** can be extracted. However, different - even contradicting - information can often be extracted from one dat source, depending on factors like perspective, interest, additional data sources or even culture.

Thus, an information system is a tool that should be able to store, transform, query, and finally present data in various ways. It i usually capable of integrating and combining data from different sources. By analyzing and interpreting this data, the data i transformed into useful information by a user. Information systems usually run on a specific computer system or over a network an require a whole suite of software packages and hardware devices.

What makes an information system a geographic information system?

A major part of human activities and decisions has a direct or indirect relation to space – a lot of data can more or less be linked to a location on earth (geographically referenced). In a GIS we can combine geographic data (or shortly called **geodata**) with othe types of information: this is what makes an information system a GIS, and constitutes as the basis for all its functionality. The aim o this lesson is to give a short introduction to GIS. The focus is on the general use, on the data and on the display of information. I lesson 2, different aspects of software and hardware are discussed. In lesson 3, different commercial products and software vendor in Switzerland are presented.

Glossary

geodata: Geographic (referenced) data: Data that includes informatio on the shape, size, exact location, etc. of an object, e.g. x, y and z (altitude) coordinates of a church, vector of its layout and height of it tower.

Learning Objectives

- You know what a Geographic Information System (GIS) is.
- You understand why there is no clear definition and the ambiguity in the usage of the term GIS
- You know the field of application for GIS and its limitations.
- You understand the difference between spatial and attribute data and know what topology is all about.

Update: 2005-01-21 (eLML) - Found a bug? - Contact - Print (PDF) - ©GITTA 2000-2005

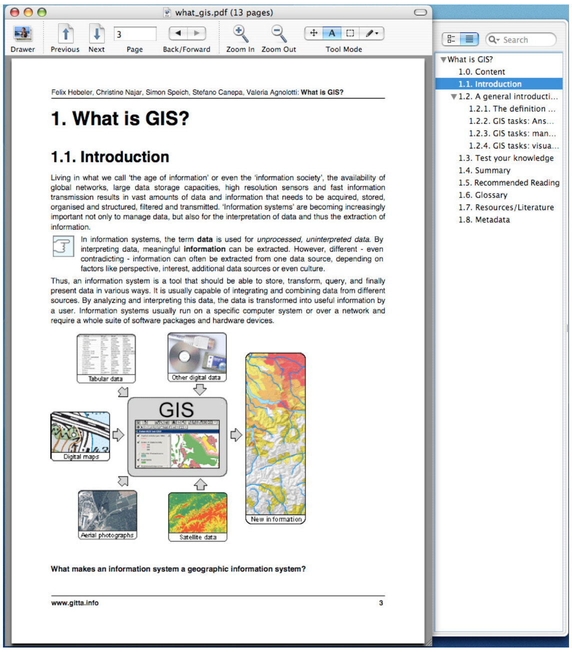
fisler (41 OLAT-Benutzer sind online) OLAT 4.0.0 (Build 089

Figure 7: Lesson imported into OLAT using IMS CP.

These examples show how lessons developed using eLML can be fully integrated into any LMS supporting the mentioned standards. It is important to understand that both the SCORM and the IMS CP standards do not define how the content itself is structured but how the lesson as a whole is built up and packed. So if a project decides to support one of these standards, there is still the need to decide on how the actual chapters of a lesson are built-up and structured. That's where eLML is filling an important gap that neither standards, SCORM and IMS CP, cover.

4.3 Print (PDF)

The print version uses the Apache Formatting Object Processor (Apache FOP, 2001) to generate a PDF document similar to the one shown in Figure 8. The FOP itself is a freely available open source product and already built into most available XML editors. Additional eLML parameters can be adjusted that impact on the final layout. These include header and footer texts, disabling the chapter numbering, language settings, etc. These options are described in detail in the eLML manual.



Felix Hebeler, Christine Najar, Simon Speich, Stefano Canepa, Valeria Agnolotti: **What is GIS?**

1. What is GIS?

1.1. Introduction

Living in what we call 'the age of information' or even the 'information society', the availability of global networks, large data storage capacities, high resolution sensors and fast information transmission results in vast amounts of data and information that needs to be acquired, stored, organised and structured, filtered and transmitted. 'Information systems' are becoming increasingly important not only to manage data, but also for the interpretation of data and thus the extraction of information.

In information systems, the term **data** is used for *unprocessed, uninterpreted data*. By interpreting data, meaningful **information** can be extracted. However, different - even contradicting - information can often be extracted from one data source, depending on factors like perspective, interest, additional data sources or even culture.

Thus, an information system is a tool that should be able to store, transform, query, and finally present data in various ways. It is usually capable of integrating and combining data from different sources. By analyzing and interpreting this data, the data is transformed into useful information by a user. Information systems usually run on a specific computer system or over a network and require a whole suite of software packages and hardware devices.

What makes an information system a geographic information system?

www.gitta.info 3

Figure 8: Lesson transformed into a PDF document.

4.4 Mobile Devices/PDA

There is a special layout version for mobile devices like PDAs etc. under construction. This layout will display a lesson in a specially adapted way so it can be viewed on small screens with low resolutions. The final version will be published on the eLML website as soon as it is finished.

5 COMPARING ELML TO OTHER MARKUP LANGUAGES

eLML must be understood as the result of three years working experience with an XML-based e-Learning content structure. It was once planned and realized but then improved over the years through author feedback and the practical experiences with it. This fact makes eLML a very easy to understand and user-friendly markup language. Today many different XML markup languages for e-Learning content exist but back in 2001 when GITTA started none of the existing structures satisfied the projects needs. They were either to complex or they were not based on a pedagogical model. The following comparison will give an overview about the differences between existing markup languages and eLML.

It is important not to confuse eLML with standards like SCORM or IMS Content Package. These standards are both supported by eLML and are only used for interoperability of content between different learning management systems (LMS). They do not describe the content itself. See chapter 4.2 for compatibility of eLML with both standards.

5.1 LMML – Learning Material Markup Language Framework

LMML, the Learning Material Markup Language Framework started in 1999 at the University of Passau (Süss, 2001). LMML is a modular language with the possibility to create new objects as needed. The LMML content objects use different semantic objects like motivation, definition, remark, example etc. In theory a very interesting approach also used by GITTA but then dropped in eLML due to pragmatic reasons as described in chapter 3.1. eLML now offers content objects like box, popup, table, list etc. whose appearance can be defined separately using CSS. But the concept of semantic distinction of objects still remains as a special attribute called "class" where the author has the possibility to define classes like "remark", "important" or "motivation" and highlight them in the layout. LMML offers a simple XSLT file for transforming a lesson into HTML (no other format supported) but does not have any authoring tools available on the website. The code has not been updated since nearly two years therefore it is not clear if the founder Christian Süss will continue this project or if LMML was only meant as a dissertation project (see Süss, 2005) and will not be updated anymore.

5.2 ML3 – Multidimensional Learning Objects and Modular Lectures Markup

A very similar markup language is ML3, the Multidimensional Learning Objects and Modular Lectures Markup Language developed at the University of Rostock together with 12 partner institutes in Germany (ML3, 2005). On the content level it works with similar educational objects as LMML (e.g. description, remark or example) therefore it seems that there has been cooperation between these Universities. However, ML3 is far more developed and still maintained. It also now offers an authoring tool based on FrameMaker.

The very brief website describes the concept of dimensions that is used in ML3. Basically a lesson can be described in three axes: Intensity (basic, advanced, expert), target (teacher or learner) and device (online, print or slide). An author, while writing a lesson, can define if a paragraph or illustration is used in the basic and/or advanced version, only on slides, visible for teachers only etc. eLML offers a similar separation by target (author and student version of a lesson) and by device (online or print). In ML3 these options lead to a total of 18 possibilities to present a lesson, so it is important that the author does not loose track about what is shown in which version and what not.

ML3 also offers the possibility to include and reuse objects in different lessons. Therefore bibliography and glossary data are stored in a database and the same resource can be used in different lessons. This is in theory a nice approach that has also been used in GITTA, but was dropped in eLML. The main reason was that one author would not accept a definition of a certain term done by another author from another institute. The authors usually want their definition to appear in their lesson. So in reality the reusability was not used at all. There were also technical reasons for dropping this feature: Maintaining a database is a lot more complicated than storing the content directly within the XML file. Furthermore validation (did the author really define the term? did he list the cited book in the bibliography? etc.) within the XML editor is only possible if the content is stored within the XML file. There were also practical reasons for dropping database bindings: Lessons in plain XML files can be transformed with every standard XML editor using standard XSLT 2.0 processors.

ML3 offers many possibilities to define self-assessments: multiple choice, yes-no questions, essay etc. eLML did not implement these options at all because we believe that tests usually need user-tracking and therefore should be implemented within an LMS. If not implemented directly in the LMS, it is not possible to store students' test-results and grades and therefore eLML only offers basic support for self-assessments.

To conclude, ML3 seems an interesting approach and it will be interesting to see the development of this markup language.

5.3 IMS Learning Design & EML

The Open University of the Netherlands developed EML, the Educational Modelling Language, which was then overtaken by the IMS consortium and is now called the IMS Learning Design Specification. This markup language is based on many different behaviouristic, cognitive and constructivist approaches to learning and instructing. It concentrates on the teaching-learning process using different roles, activities etc. around e-Learning. The actual content is stored in HTML and therefore this markup language cannot be compared with eLML. In theory it should be possible to use the IMS LD specification for describing an e-Learning module and within that module use eLML to describe the content, but this has not been tested yet.

Other XML markup languages exist and they all have their advantages and disadvantages. In the end the decision for a specific language is mostly made because of personal contacts to other users or authors. Additionally, using XSLT allows the transformation of a lesson from one XML format into another XML format. Therefore if sustainability is a major concern it is not too important which specific XML markup language is used but that XML is used at all. Because, unlike HTML where layout and content is mixed, XML offers the possibility to really separate content from presentation. A major concern when it comes to sustainability.

6 EXPERIENCES

Compared to other markup languages eLML has a very pragmatic approach and an easy to learn structure using descriptive tag names. Authors experienced with XML need less than half a day of training to be able to work with eLML. On the other hand, the lack of WYSIWY authoring tools makes eLML a rather difficult to learn markup language for authors who never worked with XML. The planned authoring tool due for summer 2006 will hopefully fill this gap.

The very rigid GITTA XML structure (the ancestor of eLML) was loosened with the release of eLML 1.0 and even more flexible with eLML 2.0. Therefore, eLML can be used for different learning scenarios as described in detail in chapter 2. On the other hand, there is a constant dilemma between having a structure strict enough to conform to a certain pedagogical model and the freedom authors want while designing lessons. With eLML we found a rather pragmatic approach to solve this problem.

The growing number of authors working with eLML pushes the development and leads to new features and new formats supported. Creating such an "eLML community" was the main idea when releasing the eLML as an open source framework. A lot of time and money can be saved if many projects work together using the same technical structure instead of each project having to start from scratch.

7 CONCLUSION AND OUTLOOK

eLML is a proven and tested approach for the creation of sustainable e-Learning content and it is also a strictly defined XML language. XML has the advantage of structuring and labelling content. As a student, in future it will be crucial to be able to find and use different e-Learning resources like, for example, the eLML-based GITTA lessons (Fisler, 2004) on the World Wide Web. The Semantic Web efforts provide promising technologies for e-Learning (Stojanovic et al, 2002). By supporting SCORM and IMS Content Packages eLML goes in the right direction. Research results how these SCORM Metadata can be integrated for e-Learning purposes are presented by Qu (2004).

ACKNOLEDGEMENTS

The work reported in this paper has been supported by the Swiss Virtual Campus (SVC) program under project no. 2001-28 and 2004-32, as well as by contributions of the University of Zurich (E-Learning Center), and of the ETHZ FILEP fund. These contributions are gratefully acknowledged.

REFERENCES

URLs listed below were last accessed on February 7th 06!

APA, 2005. *The APA Style*. American Psychological Assn. Website, Washington DC. http://www.apastyle.org/

Apache FOP, 2001. *Formatting Object Processor.* Version 0.20.5. http://xml.apache.org/fop/

Fisler, Joël, 2004. *GITTA website*. Geography Department, University of Zurich. http://www.gitta.info

Fisler, Joël, Bleisch, Susanne, Niederhuber, Monika, 2005. *Development of sustainable e-Learning content with the open source eLesson Markup Language eLML.* In: ISPRS Workshop, Potsdam, June 2./3. 2005.

Gerson, S., 2000. ECLASS: Creating a Guide to Online Course Development For Distance Learning Faculty. *Online Journal of Distance Learning Administration*, Vol. III, No. IV (Winter 2000). State University of Western Georgia. http://www.westga.edu/~distance/ojdla/winter34/gerson34.html

Holland, Matt, 2004. *Citing References: Harvard System.* Bournemouth University. www.bournemouth.ac.uk-/library/using/harvard_system.html

Horton, William, 2000. *Designing Web-Based Training*, Wiley, New York.

IMS CP, 2000. *Content Packaging Specification.* IMS Global Learning Consortium, Inc. http://www.imsglobal.org/content/packaging/

IMS LOM, 2002. *Learning Resource Metadata Specification.* IMS Global Learning Consortium, Inc. http://www.imsglobal.org/metadata/

JAXFront, 2001. *JAXFront - an XML Rendering Technology.* Xcentric GmbH, Zürich, Switzerland. http://www.jaxfront.com/

ML3, 2005. Multidimensional Learning Objects and Modular Lectures Markup Language website. http://www.ml-3.org

Niederhuber, M., Heinimann, H. R., Hebel, B., 2005. *e-Learning basierte Fallstudien zur akademischen Ausbildung in der Geoinformatik: Methodisches Konzept, Umsetzung und Erfahrungen.* Submitted to the 3. Deutsche e-Learning Fachtagung Informatik, 13.-16. September 2005 in Rostock.

OLAT, 1999. *Open Source LMS OLAT - Online Learning And Training.* Multimedia & E-Learning Services (MELS) der Universität Zürich. http://www.olat.org/

SCORM, 2004. *Sharable Content Object Reference Model.* Advanced Distributed Learning. http://www.adlnet.org

Stojanovic, Ljiljana, Staab, Steffen, Studer, Rudi, 2002. *e-Learning based on the SemanticWeb*, http://lufgi9.informatik.rwth-aachen.de/lehre/ws02/semDidDesign/lit/SemanticWebELearning.pdf

Süss, Christian, Freitag, Burkhard, 2001. *LMML Learning Material Markup Language*. IFIS Report 2001/03.

Süss, Christian, 2005. *Eine Architektur für die Wiederverwendung und Adaptation von e-Learning-Inhalten*, PhD-Thesis, University of Passau.

Qu, Changtao, Nejdl, Wolfgang, 2004. *Integrating XQuery-enabled SCORM XML Metadata Repositories into an RDF-based E-Learning P2P Network.* Educational Technology & Society, 7 (2), 51-60.

To stay informed about eLML, visit www.elml.ch or subscribe to the eLML Newsletter by sending an email with the subject “subscribe” to eLML-news-request@lists.sourceforge.net.