CREATING, HANDLING AND IMPLEMENTING E-LEARNING COURSES AND CONTENT USING THE OPEN SOURCE TOOLS OLAT AND ELML AT THE UNIVERSITY OF ZURICH

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ABSTRACT:

This paper presents two open source e-learning tools developed at the University of Zurich: eLML (eLesson Markup Language), an XML framework allowing authors of e-learning lessons to create structured and sustainable content and OLAT (Online Learning And Training), a learning management system (LMS) used by universities to manage e-learning courses, to provide collaborative tools for student groups and to run e-assessments. These tools work hand-in-hand since eLML is used to create and OLAT to present, discuss and assess e-learning content. After an introduction, the author presents both eLML and OLAT, its features but also its limitations. eLML was originally started in 2002 by the Swiss GIS-project "GITTA" and is now used by many universities or universities of applied sciences in Switzerland, Germany or Austria. OLAT was originally started as a student project in 1999 and became the strategic LMS of the University of Zurich in 2003. One year later – after a complete rebuild based on the programming language Java – OLAT was released under the Apache Open Source license and thus made available to a worldwide audience. Today OLAT is used by over 30'000 students at the University of Zurich, OLAT servers are running in over 30 countries and OLAT has been translated to 17 languages. The paper concludes with a discussion about open source software development and a short outlook.

1. INTRODUCTION: OPEN-SOURCE E-LEARNING

The Geography Department at the University of Zurich (Switzerland) has a worldwide reputation for its e-learning courses covering topics such as Geographic Information Systems GIS (GITTA Project: Bleisch & Nebiker, 2004; Purves et al., 2004), Cartography (CartouCHe project: Schnabel et al., 2007), Urbanism (GLOPP project: Müller-Böker, 2007) and other topics of research (see Kauer-Ott, 2007 for a full list of projects). Less known are the tools used to create content, to manage, and to implement the online courses at the University of Zurich. These strategic tools are eLML (Fisler & Bleisch, 2006), an XML framework to create e-learning lessons, and OLAT (Online Learning And Training), a learning management system (LMS), used to manage e-learning courses, to provide collaborative tools for student groups and to run e-assessments (Schneider et al., 2006). Both eLML and OLAT are open source projects used today by a worldwide community. Originally their development was started at the University of Zurich in 1999 (OLAT) and 2002 (eLML).

Today e-learning content and virtual course management are very important fields in higher education. The Bologna declaration (Anonymous, 1999) demands that large student groups are assessed more frequently, maximum mobility is offered to students, so that they can travel abroad for exchange semesters. Furthermore, university teaching should focus much more on electronic media, assessments and online courses. E-learning is one of the key factors when it comes to implementing the Bologna declaration and the University of Zurich developed the presented tools partly also to satisfy these demands. The paper will present other reasons why these projects were initiated over six years ago, share the experiences made developing and organizing it as a worldwide open source

community, describe how e-assessments can be carried out, plus offer some outlook into the near future and the planned enhancements.

2. ELML: CREATING E-LEARNING CONTENT

The Canadian e-learning specialist Stephen Downes calls eLML "A first-class job, something some other organizations could learn from." and asks, "Why didn't IMS or ADL or anyone else come up with something like this?" (Downes, 2007). The following pages should provide some insights about eLML and underline the statements with background information and facts.

eLML was developed by the Swiss e-learning project GITTA (Bleisch & Nebiker, 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, the consortium agreed in 2001 to use XML for the implementation and to base the XML structure on a pedagogical model. Thus, the lessons can be checked and validated for certain rules and restrictions by an XML Schema and therefore all authors must create identically structured lessons.

The launch of eLML as a standalone project came only after the official ending of the GITTA project when other projects discovered the potential of GITTA's XML structure. With minimal funding, a consolidated, server-independent and well-documented XML framework was developed in 2004. This

updated XML structure was named eLML, the eLesson Markup Language (Fisler & Bleisch, 2006) and was published as an open source project under the General Public License (GPL). Since then a constantly growing number of projects and authors in Switzerland, Germany and Austria 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.

2.1 Structuring content based on pedagogical concepts

The aim of eLML was to offer authors a tool that ensured conformity to pedagogical guidelines and thus consistency throughout all the lessons of a project. 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 or metadata, the ECLASS elements build the main structure of the XML framework. The different elements allow the creation of a pattern of learning experiences helping people to learn effectively and efficiently (Horton, 2000). Although eLML is based on a strict schema, the structure is flexible enough to allow the creation of content for different e-learning scenarios. The GITTA project created both standard e-lessons (Bleisch & Nebiker, 2004) and case studies (Niederhuber, 2005) but various projects have used eLML to create structured reports or implement other learning scenarios.

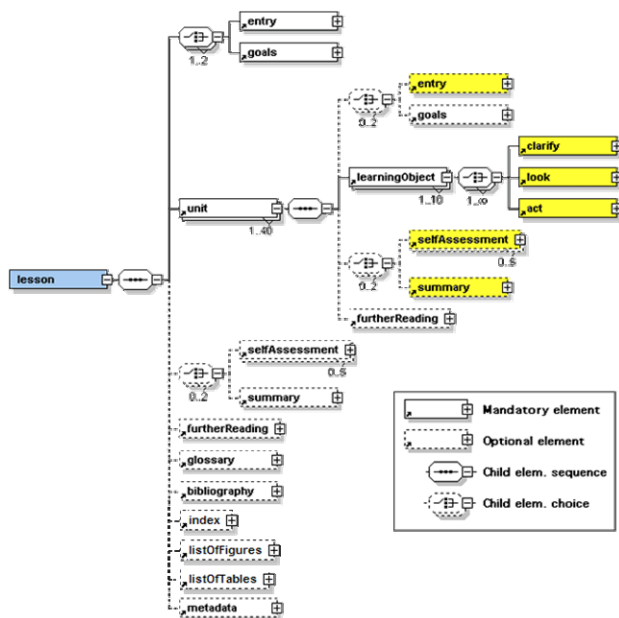The described pedagogical model ECLASS is mapped onto an XML structure using XML Schema:

Figure 1: The top-level elements of eLML (yellow=ECLASS)

An eLML lesson always starts with either the mandatory introduction (element "entry") or a concise listing of the lessons learning objectives (element "goals") followed by units. The unit elements contain the actual content of a lesson. They are built up using the ECLASS model. A unit starts again with an

introduction (*E*ntry) and the unit's goals followed by various learning objects. Each learning object describes a certain concept, model, equation, term, or process using the three elements *C*larify (theory), *L*ook (example) and *A*ct (become active) in arbitrary order. A learning object typically fits on one or two screen pages and takes the student about five to ten minutes to go through. A unit ends with a *S*elf-assessment, to check if the students understood the goals of the unit and a *S*ummary plus an optional further reading list with relevant literature.

Each lesson in eLML can have a glossary, index, bibliography and other elements described in detail on the eLML website. Using XML technology it can be checked that terms used within a lesson are defined in the glossary and that all citations, further readings and references are listed within the bibliography section. This helps to keep a lesson consistent.

2.2 Presenting content in different output formats

There are two main reasons for using an XML framework like eLML: consistency – described in the last chapter – and flexible output possibilities, described in this chapter. The basic concept behind XML and thus also eLML is a strict separation between content and layout. Once a lesson is available in the eLML format it can be transformed using standard technologies (XSLT) into different formats. eLML provides transformation files for the output formats listed in Table 2. Examples can be found either in Fisler (2006) or on the eLML website.

Output format	*Technology used by eLML:*
Web/Online	(X)HTML
Learning Management System	SCORM or IMS CP
Print (PDF)	XSL-FO
Print (LaTeX)	LaTeX
Office Document	Open Doc. Format (ODF)
Reports	DocBook Format

Table 2: Various output formats available for eLML

The format itself can be adapted using eLML templates based on the XSLT technology. A designer can create a layout for a project, which then is used to transform the project's lessons. Larger projects create different eLML templates to ensure that each partner can present a lesson using their own corporate identity. The University of Zurich is currently mentoring a Google Summer of Code project (Linowsky, 2008) whose aim is the release of an "eLML template generator" in autumn 2008. With this webbased tool the creation of templates will become feasible even for designers without any XSLT knowledge.
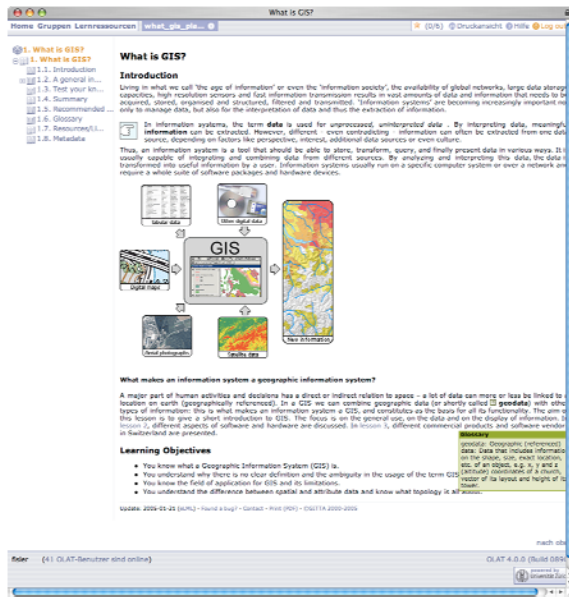
Figure 3:   GITTA lesson created using eLML and imported into OLAT using the IMS CP standard

2.3   Authoring tools to create and manage content

Currently lessons in eLML have to be written using an XML editor. This is a clear drawback of eLML and currently there are to approaches to eliminate this deficit:

1. WYSIWYG webbased eLML editor developed as a Firefox plugin and released in July 2008.
2. OpenOffice plugin to allow writing of lessons in a Word-like environment. A beta release is available on the website.

Both plugins were originally developed at the University of Zurich and are now released as open source projects. A third tool currently under development is an eLML extension for the Apache Lenya based Content Management System (CMS) called "UniCMS" (www.unicms.uzh.ch). In combination with the eLML editor, authors at the University of Zurich will be able to both manage and edit their lessons within a CMS-environment using easy-to-use tools and interfaces. Since the described tools are not yet released at the time of writing, there is no evaluation about the employment and acceptance of these tools within the eLML community available yet.

3.   OLAT: LMS TO MANAGE ONLINE COURSES

OLAT started originally as a student project in 1999. The PHP-based prototype convinced both the users and the responsible professor, which led into the development of a second OLAT release. The University recognized its potential and decided that starting with release 3 in 2003, OLAT would be the strategic learning management system at the University of Zurich. This decision created the need for new features. Due to technical limitations with PHP (see also conclusions and outlook-chapter), OLAT was completely rebuilt using the Java programming language. The resulting OLAT 4 version was released as an open source project in 2004. Other universities started to use OLAT and with the Bildungsportal Sachsen in Germany and the two Swiss spin-off companies Frentix GmbH and JLS Goodsolutions GmbH new partners contributing to the project

were found. OLAT constantly grew, new requirements led to new features added to OLAT and released as version 5 in 2006. Currently the OLAT team is working on the next release OLAT 6 due in summer 2008, including a completely rebuilt layout based on a CSS-framework called YAML. Scalability is another important issue since with up to 1000 concurrent users the servers are reaching their performance limits. OLAT 6.1 (early 2009) will offer the possibility to be distributed onto many different servers (true load-balancing).

3.1   Creating courses (authors view)

Today's learning management systems (LMS) usually cover a wide range of scenarios from enriching a lecture with PDF's or PowerPoint slides to e-learning courses thought only online without any classroom attendance. The most common use of an LMS, also at the University of Zurich, lies in between the "enriched" and the "pure e-learning" scenario and is usually referred to as the "blended learning" scenario: a lecture held at the university enhanced with online education and collaboration elements (Bachmann & Dittler, 2004). OLAT focuses both on the enriched and the blended learning scenario. The so-called "building blocks" – originally based on the IMS Learning Design approach – allow authors to create courses in a flexible way without being restrained by a rigid didactical concept. This didactical freedom is one of the most appreciated features in OLAT. The following building blocks are available in OLAT:

- *Content*: SCORM and IMS Content Packages, single or multiple pages, external content (tunneling) or download folders can be included.
- *Assessment*: Tests/Quizzes and self-tests (both based on the IMS QTI Standard), tasks and assessments.
- *Collaboration*: Forum, wiki, file dialog and chat.
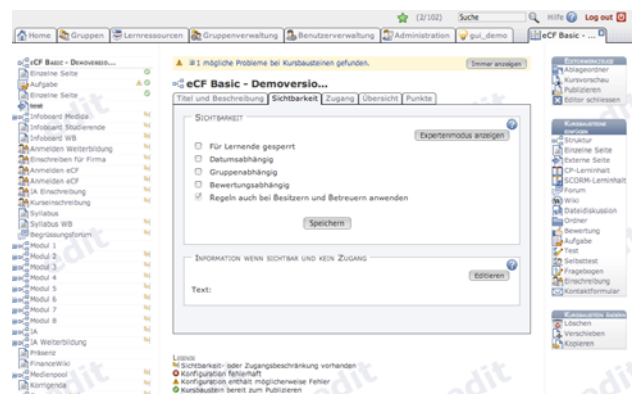- *Organisation*: Enrolment, contact form and questionnaire.

Figure 4: Screenshot of the OLAT 6 Beta version

Figure 4 shows a beta version of OLAT 6. A typical OLAT course usually starts with an enrolment for a course. A large majority of authors do not allow access to a course unless a participant/student is enrolled in the according group. These enrolments can be organized very flexible in OLAT: With or without a limited number of participants, with or without the possibility to enrol for a waiting list if a group is full, with or without automatic moving up if a space gets available etc.

The actual content of a course is usually managed with eLML – see last chapter for information about eLML – and included into OLAT via the IMS Content Package or SCORM format. Some authors prefer to include PDFs or PowerPoint slides using an OLAT download folder or just include single HTML page using the included webbased HTML editor.

Online assessments and quizzes are also handled via OLAT. Both regular tests or self-test can be created in OLAT or imported from any tool supporting the IMS Question & Test Interoperability (QTI) Specification. Regular assessments can be offered as PDF documents in OLAT and students have the possibility to both draw an assessment randomly or to first read the assessments and then pick one (according to the authors decision). The assessment building block offers a drop box where students can upload their task and a return box where tutors can return the commented tasks. All the presented assessment and testing building blocks allow tutors to rate the student with points, assigned either manually or automatically (in the case of single/multiple-choice or fill-in-the-blank quizzes) and to export Excel lists with test results of all the student. OLAT's assessment possibilities are an important factor when it comes to the implementation of the Bologna reform and thus widely used at the University of Zurich (Fuchs, 2005; Hugenschmidt, 2007; Pospischil, 2007; Schneider, 2007).

Collaboration tools found in most modern LMS and can also be found in OLAT: Forum, wiki, chat (based on the Jabber protocol and therefore also usable with compatible chat clients like iChat, Adium or PSI) and also the OLAT-specific "file dialog" block can be used within any course as often as needed. For an extensive overview about all building blocks and options the OLAT course editor offers, check the documentation available on the OLAT website.

3.2 Managing courses (tutor's view)

There are three main roles used within OLAT:

- *Author*: The person creating a course. Usually a professor/lecturer, his/her assistant or an e-learning professional responsible for creating the course. The author role was presented in the last chapter.
- *Tutor*: Persons (usually students in higher semesters) assisting the students online and/or offline. Tutors usually also grade student or issue certificates if a student has passed or failed a course. The tutor role will be presented in this chapter.
- *Participant*: Usually a student participating at a course or lecture. The participant role will be presented in the next chapter.

Tutors must both evaluate and coach students. The evaluation can be done automatically based on points earned within tests or the evaluation has to be done manually by marking tasks submitted by students within the assessment building block. These functionalities have already been briefly discussed in the last chapter. It is important to understand that the whole scoring process in OLAT is kept transparent: Each step (adding or subtracting points or evidences of achievement) is logged and both the student and the author can see how a tutor rated someone or altered a participant's rating. Since 2006 many exams at the University of Zurich – sometimes with hundreds of students – have been carried out using OLAT.

Tutors do not only decide whether a student passed or failed a class, they also coach students and help them understanding the courses they attend. Coaching means answering questions in forums, reviewing submitted assessments or documents created within wikis, discussing results using the chat etc. Using collaborative tools is only efficient if students also get a feedback or a peer-review by tutors (Jacobs, 2001).

3.3 Working through courses (student's view)

After a successful login, an OLAT user is in his or her "home". The home tab contains various so-called "portlets" that can be enabled/disabled, moved around and configured. Portlets can contain bookmarks to courses, group memberships, notes, comics, events from the calendar or important messages published by the system administrator.

Figure 5: The OLAT "home" tab with its portlets

The home tab does also contain the navigation to important features likes your own settings (language, personal profile etc.), the calendar with your own events but also the events of your courses and groups, your notes, news and RSS-feeds, your evidences of achievement and the personal folder that allows storing important documents either in your private folder or available for download to all users in your public folder.

The author of a course defines who can see his or her course. Authors can either make their courses accessible to all OLAT users, just to students from certain universities or students studying a specific topic or even just to the members of a particular group. Within a course the access/visibility settings are even more granular: Each building block allows fine tuned visibility and access-settings based on a users attributes, based on the date, based on scores achieved or based on group-memberships. These settings allow authors to setup personalized learning experiences for their students.

Unfortunately the student's view in OLAT lacks some important features. There is no ePortfolio yet integrated into OLAT. Students do have their list with evidences of achievement but nothing else. Once they finish their studies, their student account is not valid anymore and they do not have the possibility to log into OLAT, at least not at the University of Zurich. Each organization does of course have the freedom to decide for itself when to delete accounts. But OLAT lacks specific "Alumni"-features that might be important for students

to keep up with their friends from university after they finished their studies. They then have to switch to social networks like Facebook. OLAT is lacking the opportunity to keep their users bonded to its original learning management system.

3.4 Collaborative working

Collaborative working is one of the key features in OLAT. The group concept of OLAT does distinct two types of groups: learning groups belong to a course and can only be created by either the authors of a course or the tutors responsible for a course. Project or buddy groups – the second type of OLAT groups – can be created by each user and the user is free to invite any other OLAT user to work collaboratively using the group tools. Both group types offer the same tools:

- *Calendar* for group events.
- *Folder* to exchange documents (can be mounted on a user's computer desktop using WebDAV)
- *Wiki* to work collaboratively and write documents.
- *Forum* to discuss issues.
- *Chat/Instant Messenger* (either using the integrated web-client or using a compatible software like iChat).
- *List* of group members; *mail-form* to send emails to all group members etc.

These tools are only available to the members of a particular group and cannot be viewed by outsiders – not even authors or tutors – unless they are invited to the group. This assures that student can work without interference or "fear" of being controlled. How these collaborative tools are used depends both on the author and his/her guidelines and on the motivation or skills of the group members. There are different didactical scenarios that can be realized using these tools: group work, expert chats or group puzzles (Kohl, 2003, p. 20-25) are just some of the possibilities that help students get acquainted with important skills they will need throughout their career.

4. CONCLUSIONS AND OUTLOOK

It was a risky step taken by the University of Zurich to start the development of a new LMS in 1999 and a new XML-based content-creation tool in 2002. But both projects were realized in a "bottom-up" approach, OLAT started as a student project and eLML was created out of an e-learning projects' XML structure. So the decision to use these tools as strategic e-learning tools at the University of Zurich were made by the management once the tools were already created, proven and in use. The decision by the lead of the IT Services is one of the responsible factors for the longevity of both eLML and OLAT. But probably the main reason why these tools still exist today was to make both tools available to the e-learning community by releasing them under an open source license in 2005.

Figure 6 shows the amount of hits on registered accessing the eLML-website since 2005. The release of both eLML 1.0 in November 2004 and eLML 2.0 in June 2005 did not generate a lot of hits nor downloads. Release 3.0 in May 2006 did still not yet generate a lot of hits or downloads which might be an indicator that eLML was still too little known within the e-learning community. The boost came in 2007 when eLML 4.0 was released in August. Both hits and downloads are today up to ten times higher then they were two years ago.
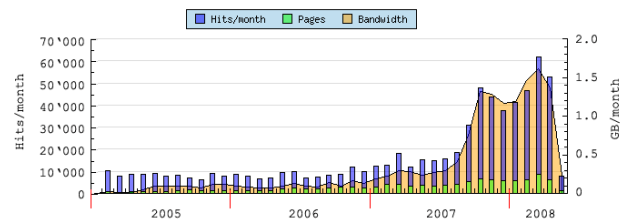

Figure 6: Hits on the www.elml.ch website from 2005 to 2008

For OLAT a meaningful measuring unit is the amount of concurrent users logged at the University of Zurich's main OLAT server (see Figure 7). The graph shows low usage during the holidays in July and August and during Christmas. The highest numbers are measured at the start of the new semester in October 2006, September 2007 – due to the Bologna reform the semester now starts in September – and in February 2008. These high peaks show up to 1000 and more concurrent user sessions. As a comparison: The official Moodl [1] documentation (docs.moodle.org/en/Installing_Moodle#How_many_users.3F) recommends 1GB of RAM for the server per 50 concurrent users. This would mean that for 1000 and more concurrent users a Moodle server would require at least 20GB of RAM. But the OLAT server works with only 2GB RAM assigned (see www.olat.org/website/en/html/download_requirements.html), both due to the technology used (Java instead of PHP) and because its code is optimized for high loads.
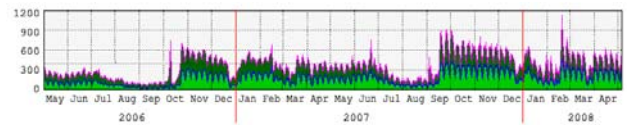

Figure 7: Concurrent users using the UZH-OLAT server

A 1000 users using OLAT at the same time is how the situation is today. This is the maximum number one server can handle. So what about next September when the new semester starts? What about 2009? The next big step in the OLAT development will be to create a scalable solution. At the moment one OLAT installation can only run on one server and the amount of users accessing the system is limited by the hardware. In future – starting with release 6.1 in January 2009 – one OLAT installation can run on different servers, the load can be distributed and thus the limiting factor will be the budget available for buying new servers. Another important issue for OLAT is accessibility. The next version of OLAT will offer an "accessibility-mode" optimized for screenreaders used by disabled students. But also the open source community is very active. Besides some plugins and extensions programmed by OLAT users in Switzerland, Germany or Italy the community contributed with a total of 17 translations of OLAT. In addition to the main European languages German, French, English, Italian and Spanish OLAT is also available in international languages like Chinese (see

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[1] Moodle is another open source learning management system comparable to OLAT. But the technology used is totally different since Moodle is based on PHP and OLAT based on Java.

Figure 8), Farsi, Hebrew, Arabic, Russian or Afrikaans. A full list including a world map of OLAT users worldwide can be found on the OLAT website.

Figure 8: OLAT 6 in Chinese

The main focus in the eLML development will be the editor for writing and editing eLML lessons. Its release is planned for summer 2008. eLML is still a very technical, XML-based solution and for many authors not useable due to their lack of XML-knowledge. In future eLML will be useable even by authors who have never worked with XML before.

Both OLAT and eLML are participating at the Google Summer of Code (GSoC) project. Students from all over the world can apply for a grant and realize a project in Java (OLAT) or XSLT (eLML). One student is creating an "eLML template generator" (Linowsky, 2008), other students are creating a blog module for OLAT, LDAP authentication for OLAT or a DocBook transformation for eLML. In total 8 student grants have been assigned to the University of Zurich and the program lasts from May to August 2008. More information about GSoC can be found on the OLAT website.

Project like GSoC are important activities to make both projects more known all over the world. A German marketing study about OLAT (Wille, 2007) found that both the acceptance of OLAT and satisfaction when using OLAT are very high compared to other learning management system. But the main problem of OLAT is that throughout the world the software is not very well-known. The community behind OLAT should allocate more resources into conferences and marketing activities. But the OLAT-team does not only participate at conferences, in March 2008 it organized its first own OLAT conferences at the University of Zurich. With nearly 200 registrations the interest was higher than expected (Fuchs, 2008). The two-day conference was a big success and a next edition is planned for 2010. Video streams of all the presentations are available on the OLAT website.

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