Design and implementation of a distance education course on open source web mapping

Authors

- **Barend Köbben**, ITC - University of Twente, Faculty of Geo-Information Science and Earth Observation, *Netherlands*
- **Ivana Ivanova**, ITC - University of Twente, Faculty of Geo-Information Science and Earth Observation, *Netherlands*

KEYWORDS : open source, distance education, web mapping, didactics

1. Introduction

In this paper, we discuss the design principles used in the development and implementation of the *Distance Education course on Open Standards and Open Source Web mapping* (DE–OSM). The main objective of this course is to teach participants about the principles of using open standards for web mapping using open source tools. More specifically, participants will learn :

- → the principles of interoperability and geo-webservices
- → the principles of open standards in the geo-domain
- → the principles of client-server architecture in the geo-domain
- → to deploy open standards compliant geo-webservcies using open source tools
- → to build browser-based clients using open source software

The DE–OSM course was developed at ITC, the Faculty of Geo–Information Science and Earth Observation of the University of Twente. ITC is an institute that aims at capacity building and institutional development in various fields that include the use of Earth observation, collection and management of spatial information, and the development of data integration methods.

Published in: Symposium Proceedings Open Source Geospatial Research and Education Symposium, Oliver Ertz et al. (ed.). : OGRS2012.org , pp. 93-101

2. Design of the course

The DE–OSM course is designed as a *self-instructive distance education* course. The main reason for choosing a *distance education* format is to offer students a learning environment that can be accessed in *their own time*, and can be processed at *their own pace* in *their own location.*

The course being *self-instructive* means that the content of the course itself acts as a teacher. This may sound obvious, but it is quite difficult to apply sound instructional principles in content material for 'distant' students, as compared to'face-to face' students. The material in any lesson must explain itself. It also has to provide everything necessary for the student to behave in a self-instructive manner, and to gather the knowledge required. To reach these goals, the DE–OSM course applies the didactic approach known as the ICARE (Introduce, Connect, Apply, Reflect, Extend) system, supported by the principles of instruction theory [9]. ICARE is a five-part system that borrows aspects from various taxonomies, including Gagn´e's Nine events of instructions [3], Merill's Component display theory [8], and Bloom's Taxonomy of higher order learning [1].

The DE–OSM course is offered as a set of stand-alone course components, accessible in an order as preferred by the student. The course set-up and structure naturally suggest an ideal path through the material, in which a lecture is the central course component. A lecture acts as the 'knowledge glue' that helps the students in constructing their new knowledge. This approach arises from the characteristics of the topic (fundamentals of open standards and open source web mapping), since it introduces principles (axioms, theorems, and base skills). The expected entrance knowledge level is low; therefore, it is less suitable to allow students (who do not yet master the principles) to formulate their own opinions through the application of collaborative pedagogical methods. Collaborative learning techniques, such as discussions and collaborative presentation, are more suitable for advanced students and we apply them towards the end of courses.

The content of the course is self-explanatory, meaning that the student should find everything he or she needs for comprehension of the course content in the provided materials. This approach allows the teacher to act more as a tutor than a sage during the course. This significantly decreases the staff time required

Published in: Symposium Proceedings Open Source Geospatial Research and Education Symposium, Oliver Ertz et al. (ed.). : OGRS2012.org , pp. 93-101

to run the course. Although the time invested by the tutor during the course is diminished, the students' performance remains of interest to the tutor. Discussions will be stimulated and must be carefully monitored. Depending on the length of a course, the content may be divided into units and every unit consists of lessons, where the lesson is the main Learning Object (LO). The term "Learning Objects" started to find its way into the world of education at the end of the 1990s. LOs are "instructional components that can be reused a number of times in different learning contexts" [10]. Learning objects are the most basic building block of a lesson or activity, and they are :

- searchable
- usable in any learning environment
- capable of being grouped or to stand alone
- transportable from course to course and program to program

In our course design, we adopted Chiappe's definition, in which an LO is "a self-contained, reusable entity with a clear learning aim that contains at least three internal changing and editable components: content, instructional activities (learning activities), and context elements" [2].We chose the lesson as the main learning object. It has clearly stated objectives, has well-defined and limited content, and can be assessed. All elements used to build such an LO are seen as course components.

Lessons in ITC's distance courses typically have six types of components: [1] introduction (in the form of a study guide), [2] lecture(s), [3] demonstration(s), [4] exercise(s), [5] self-test(s) and [6] a reader or book. A general overview of the didactical structure of distance education courses at ITC is provided in Figure 1. Some of these components are not independent, and only make sense in combination with their specific reference component (e.g. a demonstration that explains a certain action described in the lesson). Other components can easily be reused in other lessons in another context (e.g. a reader or exercises).

Of course, any course design should also take into account the skills and background of the potential participants. In our case, the target audience is primarily the staff of European national mapping and cartographic agencies and other organizations with a need for using open source web mapping. Advanced students in the geo-domain that want to apply open standards and open source web mapping in their studies are also considered as part of the target group.

Published in: Symposium Proceedings Open Source Geospatial Research and Education Symposium, Oliver Ertz et al. (ed.). : OGRS2012.org , pp. 93-101

We expect these participants to be advanced learners, with a professional understanding of the underlying principles of geo-data.

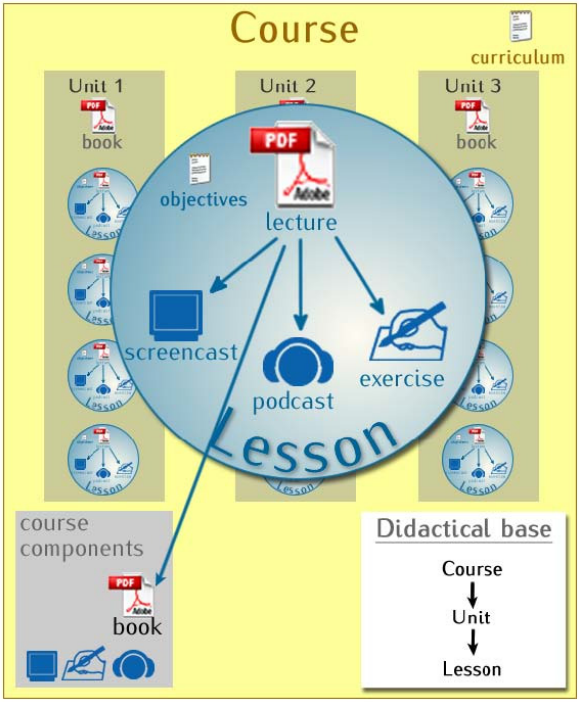

FIGURE 1

Didactical structure used in distance education courses at ITC. Note that not all elements are necessarily used in all lessons (e.g. the DE–OSM course has no pod- and screencasts)

In the paper, we will describe in detail how we applied the didactic principles and the distance education framework we developed at ITC for the particular target group of the two week DE–OSM course.

3. Implementation of the course

The course is accessible through a Learning Management System (the current version of the course runs on the Moodle platform), requiring only a web browser on the student's end. This LMS allows students to interact with tutors, by means of a discussion board. Since the LMS client contains an automatic update mechanism, students will always access the most up-to-date version of the course. The elements of the courseware (reader, lectures,

Published in: Symposium Proceedings Open Source Geospatial Research and Education Symposium, Oliver Ertz et al. (ed.). : OGRS2012.org , pp. 93-101

exercises) are offered as interactive PDF files. The DE–OSM course provides the participants with knowledge and tools to set up a web mapping application according to the principles of what we call **SDI^{light}** . The term SDI for Spatial Data Infrastructure may be usually connected with (very) large regional or national spatial data warehouses, but the principles of SDI can also be applied in more simple and cost–effective ways. The down–to–earth approach of SDI^{light} provides students with a platform for relatively simple, low–cost, yet powerful ways of sharing data amongst various distributed offices and institutions as well as the general public. To achieve this, we use open standards whenever available and open source solutions where possible. More on the SDI^{light} approach can be found in [7].

SDI^{light} building blocks are open source tools and include :

- a PostgreSQL/PostGIS spatial database back–end that stores the spatial data using the Open Geospatial Consortium Simple Features specifications
- MapServer, the server applications that allows dissemination of spatial data over the Internet, which is fundamental requirement for web mapping
- simple browser-based clients enabling access to the required maps and data. At present, we employ various techniques such as dynamic `HTML`, eXtensible Markup Language, asynchronous JavaScript (using the OpenLayers application programming interface) and the Scalable Vector Graphics image format

3.1 Lecture - the knowledge glue

In our course, the lecture acts as the *knowledge glue*. The lecture draws together ideas presented in other elements of the courseware (reader, demonstration, exercise, self-test). We typeset most of our courseware using LATEX, a high-quality typesetting system based on TEX, developed by Donald Knuth in 1978 [6]. The scripting language used in the course (JavaScript and `HTML`) has a special flavour, by which we mean native code typesetting and use of colors in most interpreters is catered for by using a special styling in LATEX, namely the modified `lslisting` environment. Authors of the lecture can simply copy code snippets from the interpreter and paste them into the `.tex` source file of the lecture.

Published in: Symposium Proceedings Open Source Geospatial Research and Education Symposium, Oliver Ertz et al. (ed.). : OGRS2012.org , pp. 93-101

All that is required is to insert a piece of code into the `.tex` file of the lecture such as the following :

```
begin{lstlisting}
   Map types produced by Lovely Maps:
   <ol>
       <li>tourist maps</li>
      <ol type=i >
          <li>monochrome </li>
          <li>colour</li>
      </ol>
       <li>location maps</li>
       <li>route maps</li>
       <li>imaginary maps</li>
   </ol>
\end{lstlisting}
```

The above example will be typeset as shown in Figure 2. As mentioned earlier, the DE–OSM lecture didactical system sees the lecture as *knowledge glue*. This is exemplified by a multimedia strip on the right margin of the lecture page. Every page of the lecture can point to a (video) demonstration, an exercise, and/or a specific location in the reader.

3.2 Software installation

Our technical realization reduces the initial technicalities related to installation and optimization of the work environment. This allows students and tutors to concentrate on the principles of web mapping and leave the installation details for later. The LMS client interface also allows students to interact with tutors, by following the discussion board. Since the LMS client contains an automatic update mechanism, students will always access the Design and implementation of a distance education course on open source web mapping 5
Figure 2. Lecture in DE–OSM most up-to-date version of the course.

Web mapping technology required by the content of the course is installed on ITC's servers and is accessible to the students. Once the course is finished, students will receive installation instructions to be able to replicate the set-up

Published in: Symposium Proceedings Open Source Geospatial Research and Education Symposium,
Oliver Ertz et al. (ed.). : OGRS2012.org , pp. 93-101

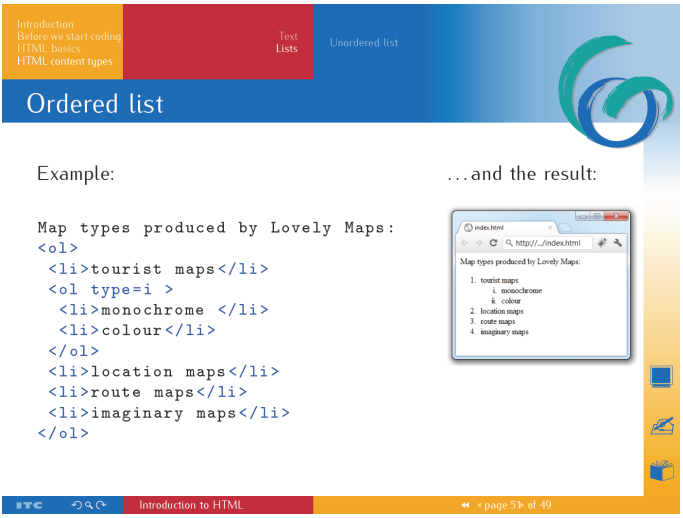

FIGURE 2
Lecture in DE–OSM

at their own location. Although the nature of studying of a scripting language and web application building is through self-study, this client-server solution also allows components of the course to be deployed in a face-to-face setting, as well as in the distance education mode.

3.3 DE course execution

The duration of DE–OSM course is two weeks. We expect that students will study parttime.As our previous experience shows, studying part-time means perhaps a few hours in the evening, but mostly during the weekend. This typical study behavior strengthens our choice for self-instructive nature of the course.

Assessment is twofold :

1. testing the theoretical knowledge with tests conducted in LMS
2. testing the practical knowledge through an assignment to build a web map application

Testing will be scheduled only at the end of the course. We allow the students submitting their web map applications one month after the course.

Published in: Symposium Proceedings Open Source Geospatial Research and Education Symposium, Oliver Ertz et al. (ed.). : OGRS2012.org , pp. 93-101

4 Results

One of the key objectives in the design was to lower the need for tutors' input during the course, without letting the student drown in lecture notes, readers, articles and instructions. We expect the design principles behind this course to ensure that this objective can be met, because they have been successfully applied in earlier, comparable, courses (e.g. [4], [5]).

At the time of writing this extended abstract, a first group of 24 participants has just finished the first run of the two week DE–OSM course. We can at this moment conclude that they by and large have been very actively involved and have finalized the course with the expected achievement : They have produced a working web mapping application according to the specifications given to them.

In the paper, we will look more closely to the course results as well as data we are currently gathering from the participants, to give a critical evaluation of the success of our approach.

Acknowledgments

The DE–OSM course was offered as part of the EduServ10 series (http://eurosdr.net/eduserv10) and its development was supported by EuroSDR funding.

[1] BLOOM, B. S. *Taxonomy of educational objectives*. Longman, New York, NY, USA, 1956.

[2] CHIAPPE LAVERDE, A., SEGOVIA CIFUENTES, Y., AND RINCÓN RODRÍGUEZ, Y. Toward an instructional design model based on learning objects. *Educational Technology Research and Development 55*, 6 (2007), 671–681.

[3] GAGNÉ , R. M. *The conditions of learning.*, 4 ed. Rinehart andWinston Hold, New York, NY, USA, 1977.

[4] IVÁNOVÁ, I., DE BY, R. A., BAKKER, W. H., KOOISTRA, J. F., FERINGA, W. F., AND RETSIOS, B. Principles of databases : distance education., 2010.

[5] IVÁNOVÁ, I., HUISMAN, O., DE BY, R. A., FERINGA, W. F., BAKKER, W. H., RUTZINGER, M., AND RETSIOS, B. Programming skills: distance education., 2010.

[6] KNUTH, DONALD, E. *The TeXbook*. Adison-Wesley, Reading, Massachusetts, USA, 1984.

[7] KÖBBEN, B., FOERSTER, T., LEMMENS, R., BY, R. A. D., HUISMAN, O., AND MORALES, J. Using the SDIlight approach in teaching a geoinformatics master. *Transactions in GIS 14*, s1 (2010), 25–37.

[8] MERILL, D. M. Instructional transaction theory: Instructional design based on knowledge objects. *Educational Technology 36*, 3 (1996), 30–37.

[9] PASTOR, N. The ICARE system. In *Encyclopedia of Educational Technology*. San Diego State University, 2000.

[10] WILEY, D. A. Connecting learning objects to instructional design theory: A definition, a metaphor, and a taxonomy. In *The Instructional Use of Learning Objects*, D. A. Wiley, Ed. Association for Educational Communications and Technology, 2001, pp. 1–35.

Published in: Symposium Proceedings Open Source Geospatial Research and Education Symposium, Oliver Ertz et al. (ed.). : OGRS2012.org , pp. 93-101