Modern Education at Universities: Improvements through the Integration of a Spatial Data Infrastructure SDI into an e-learning Environment

Ingo Simonis
Institute for Geoinformatics, University of Muenster
Robert-Koch-Strasse 26-28
48149 Muenster, Germany
+49-251-83-30057, +49-251-83-39763
simonis@ifgi.uni-muenster.de

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ABSTRACT: The integration of spatial data infrastructures (SDI) into the educational work at universities represents a novelty to the e-learning environment. The active component is one of the most important issues in the field of effective learning as shown in the cognitive apprenticeship approach (Collins et al., 1989). Therefore the goal should be to facilitate an environment that gives the student the possibilities to make use of his newly achieved knowledge, to test his capabilities and to discuss his own results with others. This paper describes a first approach, how interoperable services sustain the process of learning complex issues in the field of geography related courses of studies.

1 INTRODUCTION

The design of lectures given at universities has been changed in recent years. Digital projectors have replaced the old style overhead projectors. Black boards are even less used in these days. Lectures supported by slides provide a more intense perception of the issue under discussion. Often, these slides are freely disposable over the internet. Students are able to download the material in advance and – depending on the slide structure – put notes on printouts during the lecture. Up to this point, the use of freely disposable digital online material could be very useful. The problems arise in the moment the student tries to rework past sessions. Simple slides do not help to remember the often complex and difficult subjects. An alternative is the online lecture, consisting of html-sites with continuous text, formulas, pictures, and examples. But this design is very work-intensive to produce and to maintain. Finally all approaches lack the possibility for the student to test his newly achieved knowledge actively. The active component is one of the most important issues in the field of effective learning as shown in the cognitive apprenticeship approach (Collins et al., 1989).

Therefore, lectures are commonly accompanied by seminars in which the students have to make use of the discussed information. In the area of GIS-education, practical work in class heavily depends on data availability. Very often a tremendous effort is necessary to provide suitable data. The approach discussed in this paper demonstrates the capabilities provided by a spatial data infrastructure SDI in supporting modern learning systems. It will show how students are enabled to sift through the provided data visually or make choices based on the attached metadata. A current research project at the University of Muenster investigates the usability of SDI-components to create an e-learning environment.
2 Spatial Data Infrastructures

Spatial Data Infrastructures enable a so far unknown efficiency regarding the work with spatial data (Bernard, 2001; Rieken, 2001). Recent research work claims that SDI has to be understood as a spatial information infrastructure rather than a spatial data infrastructure (Bernard, 2002). In the case of making use of SDIs within an educational network, the former definition still proves validity. Main goal of the SDI used within this project is to facilitate the students with suitable data. The processing capacities that are offered by spatial information infrastructures are not yet as powerful as the ones provided by locally installed software. This will change in the next years, but for now we have to narrow down the use to search and access spatial data.

2.1 Interoperability in the Geo-processing Domain

“Classic GIS are still monoliths” is a statement that remains valid (Bernard et. al 2002). Nevertheless, some very promising activities have occurred in the last years. The most important ones are those of the OpenGIS Consortium (OGC). The OGC was founded in 1994 and is an international industry consortium of more than 220 companies, government agencies and universities participating in a consensus process to develop publicly available geoprocessing specifications (OGC, 2002). These specifications serve as a generic programming interface and allow the interoperation of different GIS components. Recently a number of data access services have been specified finally.

The Basic Service Model, developed in the OGC Web Map Testbed II defines three prerequisites, which have to be met by any conforming GI-Service. Firstly, it has to be spatial referenced, secondly, it has to provide a minimum set of metadata, and thirdly, it has to be a web service (OGC 2001a).

The OGC Web Service specifications defines Registry Services for cataloguing and investigation of GI services, Catalogue Services for cataloguing and investigating geodata, Map Services to visualize the geodata, Feature Services for input and query of vector data, Coverage Services to query raster data geoobjects, and Coordination Transformation Services to transform geodata into a shared reference system.

The key-services needed to establish a usable service-platform for E-learning are:

- Data Searching Service
- Data Visualization Service
- Data Access Service

3 E-Learning

After hours of lectures, an active employment with the newly achieved knowledge helps to improve the learning success and to discover gaps in one’s knowledge. Most universities provide computer pools with a bunch of geoprocessing software installed. Nevertheless, it is difficult to find suitable projects for students to make their own experiences. Mostly, the problem is data.

3.1 Data

The widespread problem of the lack of suitable data is due to the data access policies in Germany. In contrast to American policies, where most of the data that is achieved by federal agencies using tax money is freely available, data has to be bought at enormous price levels. Even if data is bought, it has to be processed to adapt it to the needs of teaching in class or
self studying purposes respectively. Making use of American geodata is nothing more than a poor workaround. Firstly, the local aspect is missing completely. Secondly, in most of the cases suits the data the needs only insufficiently.

If different data-sets are needed for different teams, editing and processing of the data could be very time consuming. A solution to this plight could be an intensive exchange of data, that is held by each university individually and that is free for educational purposes. It is obvious that the intensive data exchange will lead to further problems regarding to data security and legal rights particularly.

3.2 GI-EDUCATION AT UNIVERSITIES

The potential of integrated SDIs into the daily lectures is beyond dispute. Nevertheless, it has to be taken into account that is not possible to build up all the necessary web services to teach the broad range of aspects in geoinformatics. Usually, commercial-of-the-shelf (COTS) GIS products are used to teach how to handle geodata. This aspect influences the overall design that is chosen within this approach (Figure 1), realized with ESRI®-products.

Figure 1: Architecture with SDI and COTS

3.3 SDI IN THE ACADEMIC ENVIRONMENT – A CASE STUDY

Using SDI components within the entire process from the data investigation until the final access to a single feature, map, or coverage, etc. has a lot of advantages. One of the main improvements is that the student has to learn which steps are necessary to retrieve the appropriate data to solve his needs. The lecturer will not any longer pass simple shape files around, but specifies the task, announces the URL of a Catalog Service and moves the data acquisition process to the students.

3.3.1 Step 1, finding data

Students query the Catalog Service with the necessary parameters. This Catalog Services as well as the registered data could be distributed over the entire WWW. Universities become able to exchange data easily. Metadata is an issue that arises quickly if looking for suitable data. The metadata format favored by OGC is ISO 19115, “Metadata for Geographic Information”. First tests have shown that this standard is much too big to be used within the educational environment at universities. You can argument that a subset of ISO 19115 would be suitable. That’s correct to the point it might be possible for all data providing institutes to fulfill the mandatory subset. The problem was discussed in 3.2. Most of the universities in
Germany use ESRI products. The current versions use only an ESRI-specific subset of the FGDC-standard. Even this subset is much too expensive to maintain for educational reasons. A further reduction of this subset seems to be a good idea. The other way to investigate the available data is to make use of the COTS. These products often allow you to do even the next steps within a data acquisition process, i.e. to investigate the metadata, to get a visual impression of the data, and to download it if it suits the needs.

3.3.2 Step 2, investigating data

Map- and Coverage Services are used to get a first visual impression of the provided data. Web clients have to be developed to make use of the products provided by these standardized services. Once again the available equipment has to taken into account. A twin-track approach is unavoidable: Web clients that are able to request and visualize the maps as well as clients that suit the COTS, like an ArcIMS by ESRI, for example.

3.3.3 Step 3, accessing data

The data access is the part in which SDI’s do not play an active role in the learning environment so far due to the fact that processing services are not specified yet (the Coordination Transformation Service is the only exception). Students will not be able to use geodata that is encoded in GML (at least in first semesters, the target audience of the entire project). COTS products are still the first choice. They provide access to file systems with most of the common used file types as do allow direct access to spatial databases and spatial database engines, i.e. ArcSDE by ESRI.

3.3.4 Summary

The fact that the entire data acquisition process is done by the students themselves encourages them to understand the entire process from the data search to integration problems. They learn how to deal with different search mechanisms, how to use metadata, how to access data in different ways and how to handle the integration problems.

3.4 Benefits from SDI-Integration

The advantages from standardized spatial data infrastructures, like those defined by the Open GIS consortium, could not be used entirely within the daily work in lecture halls. The products allow a constructive teamwork only to a certain amount. The focus still lies on commercial of the shelf products. This will change if more processing capabilities will be available. For now, SDIs play their active role particularly in the area of data search.

References:


